AMERICAN MACHINIST

A JOURNAL FOR MACHINISTS, ENGINEERS, FOUNDERS, BOILER MAKERS, PATTERN MAKERS AND BLACKSMITHS.

VOL 11, No. 53. WEEKLY. | NEW YORK, DECEMBER 31, 1888. | $2.50 per Annum. SINGLE COPIES 5 CENTS.

COPYRIGHT 1888, BY AMERICAN MACHINIST PUBLISHING COMPANY.

For Sale Everywhere by Newsdealers.

ENTERED AT POST OFFICE, NEW YORK, AS SECOND CLASS MATTER.

Eberhardt's Automatic Rack Cutter.

The engraving on this page represents a machine which is probably destined to play an important part in the manufacture of machinery in which cut racks are used, and also to make possible the use of racks accurately cut in many cases where cast racks are now used. It is entirely automatic in its movements, feeding the cutters through, running them back with a rapid motion, moving the blank along the proper distance for the next cut, starting in the feed again, and so on to the end of the rack, when an automatic movement shifts the belt and stops the machine. It will cut racks up to 8″ face, and has a continuous movement of 36″, racks exceeding this length in a single piece being cut to any desired length by shifting in the vise.

The essential parts of the machine consist of a bed piece, to the top of which at the rear is bolted a substantial upright or housing. In front, and fitted to the same bed piece, is a cross-block, having upon its upper face a cross slide which carries the rack to be cut.

The face of the housing forms a sliding surface upon which works the saddle which carries the arbor and cutters; its motion, when cutting, being vertically downwards.

On the side of the machine not shown in the cut are the pulleys by means of which the various parts of the machine are driven, a single belt passing from the countershaft around the pulleys, which drive the arbor spindle, the feed mechanism and the dividing mechanism.

The latter is much the same in principle as is used on the Gould & Eberhardt automatic gear cutters, but is stronger and has a more powerful action. Part of this mechanism is shown at the end of the cross slide, all the gears which require to be changed for different pitches being outside, and easy to get at.

The cut shows the saddle which carries the arbor, near the end of its upward or backing movement, and in contact with the adjustable stop which trips the dividing mechanism. After this has been set in motion, the saddle continues its upward movement for a short distance, until it comes in contact with the stop, which is on the other rod further to the right, the upward movement of which throws a clutch and reverses the movement of the saddle. It then feeds down through the cut until it comes in contact with the lower stop on the same rod, by which the clutch is thrown the other way, and the saddle rapidly returned. The change gears for the various feeds are at the extreme right, near the floor.

The clutch which moves the saddle can also be thrown in or out by the vertical lever at the side of the machine, and when thrown out, the saddle can be moved up or down by a crank handle, which fits the square formed on the end of the shaft at the right. The same crank also fits the end of the dividing screw for moving the cross slide by hand, the gears being thrown out of action by loosening the turn button shown, and moving the lever to which it is attached.

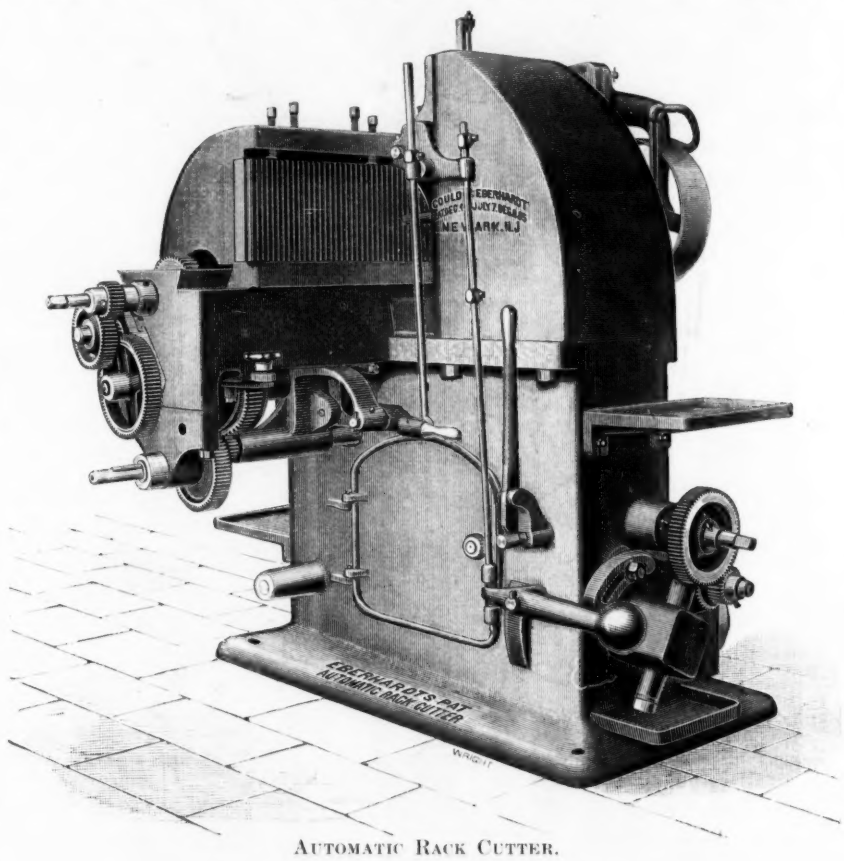
The machine divides either diametral or circular pitches, the placing upon, or removing from the lower shaft of a single gear wheel, being all that is necessary to change from one to the other. Special attention has been given to making the machine amply strong for the work, whether cutting cast-iron or steel, it being intended to use a gang of cutters upon the arbor, all of which may be finishing cutters, or part for roughing, as may be preferred. For racks of 6 diametral pitch, six cutters may be used, and for other pitches (coarser or finer) in proportion.

Complete tables are furnished with each machine, giving the number of cutters intended to be used, the gears for dividing, and for feeding in both cast-iron and steel.

The saddle is counterbalanced by a lever and weight which are on the side of the machine not shown, and on this side there is also a small pump, which keeps a continuous stream of oil or other lubricant flowing upon the cutters when cutting wrought metal, special provision being made for catching and returning it, together with the chips, to a small tank at the side of the machine, where the chips are separated, and the lubricant again flows to the pump. The fact that the cut is in a downward direction, and that a copious stream of oil can be kept flowing upon the cutters, obviates all trouble from the clogging of the chips in the teeth of the cutters, and makes it possible to drive them at the maximum speed and feed.

The driving belt is 3½ inches wide, and the pulley which drives the cutter spindle is 14 inches diameter, geared to make 12 revolutions to one of the spindle. The movement of the cross block on the bed is by a screw and hand-wheel, graduated to thousandths of an inch, for setting the cutters to the proper depth.

Altogether, the machine seems well designed for the purpose intended, and will be likely to find a place in many shops where much rack cutting is to be done. Its weight, complete, is about 5,000 pounds. The builders are Gould & Eberhardt, Newark, N. J.



AUTOMATIC RACK CUTTER.

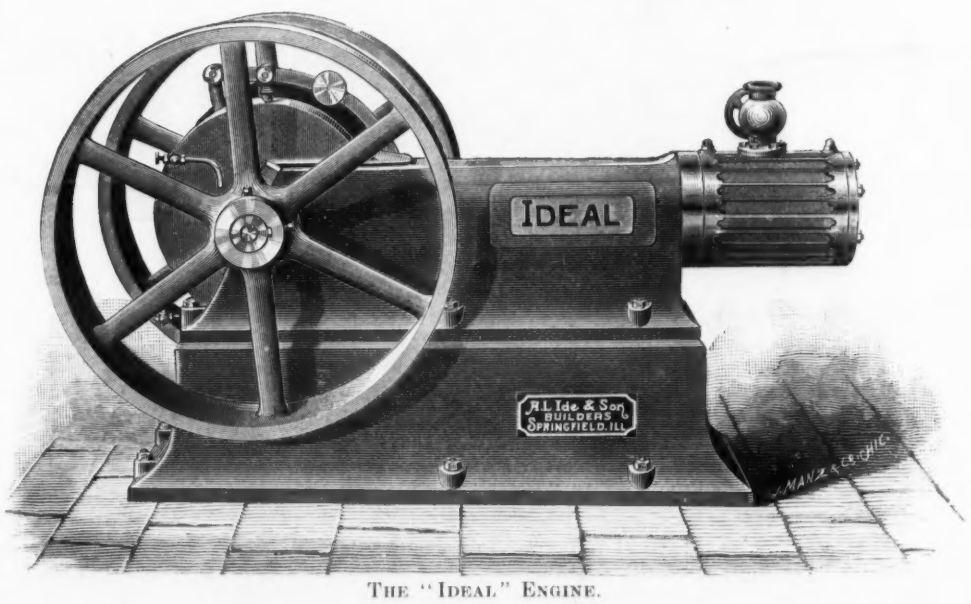
The "Ideal" Engine.

We illustrate on this page, and on page 2, the "Ideal" engine, made by A. L. Ide & Son, Springfield, Ill. The engraving on this page gives an idea of the general appearance of the engine. It will be seen that it is compact, and that the construction is such as to give the required strength for high speed. It may be remarked that, in the design, ample wearing surfaces are provided, and that all the parts are made of steel, phosphor bronze and charcoal iron, and are fitted to templates, so as to insure interchangeability. Every engine is tested by being run in the works, and valves and governor are properly adjusted for varying loads and steam pressure.

Fig. 2, page 2, shows a section of the engine, and illustrates the self-oiling arrangement for the guides and crosshead pin.

It will be seen that the oil is thrown upon the guides, and, being wiped from the top guide by the slide, passes through a tube in the top slide, entering a funnel in the connecting rod, and, after passing through the bearing, drips to the bottom of the crosshead. The piston rod also receives its share of lubrication, the advantage of which is obvious.

Fig. 3 is a section through the crank disks and main shaft, which is of hammered open-hearth steel. It shows the method of oiling the main bearings and crank pin. It will be seen that an oil chamber is provided under the two crank disks, which is supplied with enough oil to ensure the disks dipping into the oil. When the engine disks are in rotation, the centrifugal force causes the oil to be thrown into pockets provided in the hood over the disks. From these pockets the oil flows through the pipes into a receptacle or pocket cast upon the main bearings. From this point it flows into the groove and channel connecting with the crank-pin, which is hollow. The centrifugal force carries it into the crank-pin, from which it escapes through two holes into the bearing. Thus it will be seen that the main bearings receive constant lubrication, while the lubrication of the crank-pin is ensured by the supply of oil from each side. This method of lubrication is constant and perfect, and provides for the most important bearings about the engine. Sufficient oil is placed in the basin under the crank disks so it will flow in streams through both pipes to main shaft bearings, and in drops to the eccentric, but valves are provided on the pipes, so that the supply can be regulated as desired, and the oil chamber or basin can be supplied with fresh oil while the engine is running. The oil from this chamber can be drawn off by a cock in end of frame communicating with the pocket, and be used over again. Besides the saving in oil, these devices keep a clean and presentable engine and engine room.



THE "IDEAL" ENGINE.

The governor is shown in Fig. 4. All its parts are in sight, and are readily accessible for cleaning. It is secured to the side of fly-wheel, and connects through an eccentric on the main shaft direct to the valve, without the use of gearing, pulleys, shafts or belts. It is attached to the valve direct, and gives an open port at the beginning of each stroke, admitting steam to the piston head at about full boiler pressure, and varying the point of cut-off, as the resistance requires, from the beginning to three-fourths of each stroke. It acts instantly, and cuts off the steam at a point that will just do the work and maintain the fixed speed of engine. The variation of speed from no load to the full power of the engine, it is said, will be less than one per cent. The dash-pot attached to the eccentric controls the movement of the weight, preventing any sudden movement or jumping of the weight when a great change of load occurs suddenly. The normal speed of the engine may be changed to suit requirements, by shifting the weight. No oil cups are used on the engine, no oil is thrown on the belts and engine-room floor, and the engineer has no use for oil cans.

The valve is of the hollow piston type—a hollow tube with a piston at each end. It is surrounded by steam, which presses equally on each end, thus perfectly balancing the valve and relieving it from pressure or friction. When the bushings are worn, they can be withdrawn and new ones inserted, and a new valve furnished, without delay, at small expense. The piston head is a single casting, hollow, and as light as consistent with strength.

Safety caps are attached to the cylinders, which, in the event of flooding or foaming of boilers, will protect the engine from damage or breakage, by bursting and allowing the water to escape from cylinder. In the case of the bursting of a safety cap, it can be quickly replaced at a trifling expense.

The crosshead is a crucible steel casting, with phosphor bronze gibs. It is of box form, and a hardened steel pin is inserted.

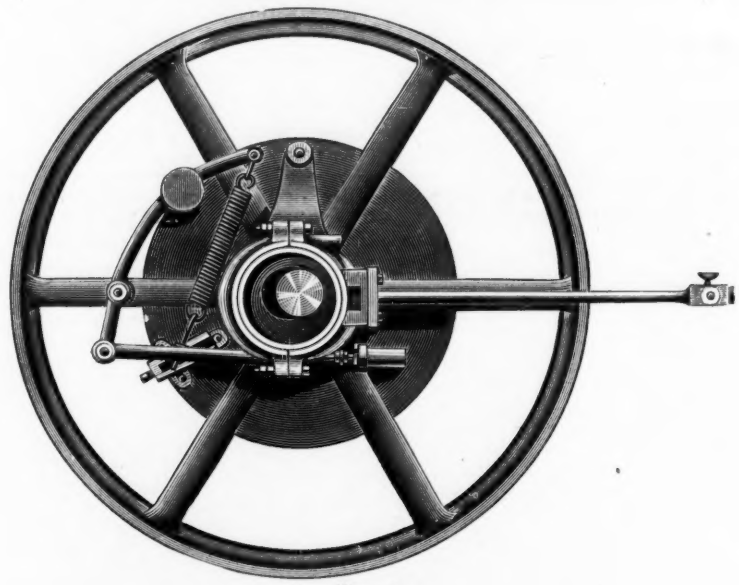


FIG. 4.

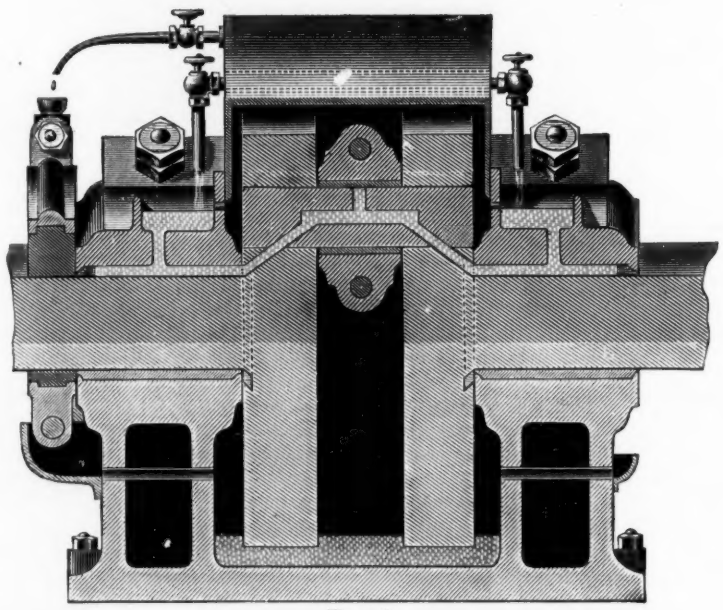


FIG. 3.

A New Year's Gift for the Foreman.

BY FRANK RICHARDS.

There are wise and successful managers who will be shocked by my title. It is held to be improper for workmen to give or for foremen to accept presents. It is a species of bribery and a temptation to favoritism. It is not a thing to be encouraged. It may do harm, and it can't possibly do any good. This opens a great practical question that I will not venture to stir very deep. Indeed, I rather propose to evade the question entirely. I will do so by suggesting a gift that cannot possibly carry with it any presumption of bribery, but which will, nevertheless, be very gratifying and encouraging to the foreman. Just make him a present of a resolution.

Gifts mostly belong to Christmas, but what I propose is more appropriate to the New Year. The habit of making new resolutions with and for the New Year is, I suppose, universal. We are apt to ridicule it a little, whether in ourselves or in others, and are perhaps ashamed of it as a kind of weakness; but still, as the years come around, we continue the time-worn custom. Well, it is no weakness, and there is nothing to be ashamed of. The resolution for the future is at least a confession and apology for the past; and that is manly. And it cannot be that all the bountiful blossoming of New Year resolutions is whirled away to fruitless oblivion. I have in my narrow acquaintance in at least two or three instances known New Year resolutions to yield life-long fruits of noblest substance.

I always think of the AMERICAN MACHINIST as one big machine shop, and I imagine its readers to represent, as I know that they do represent, all the classes to be found in the machine shop anywhere; and if I want to say a word that any machinist, as a machinist, can take home to himself, I know that I shall hit him if I fire into this audience. From my life-long knowledge of the shop, I am safe in saying that some of you fellows who may be doing me the honor of reading these lines, have at least one bad habit, a very bad, if not a very big habit, a habit that is a source of much unpleasantness, a habit that entails evil consequences, altogether out of proportion to the magnitude of the thing itself. The resolution that I am proposing as the most welcome of gifts to the foreman at this time of good will, has to do with this bad habit. All I am asking of you is that you will try to conquer your bad habit of coming late to your work; that with the New Year you will resolve to try to get to work on time.

There, I've only succeeded in putting it in a cowardly way after all, and not in the way that I mean. It is not a thing to try to do. Don't try to do it any more. You've been trying to do it long enough. Just take and do it, and it will be done. It is perfectly fair to suppose that, if Nelson's flag at Trafalgar had read: "England expects every man to *try* to do his duty," the battle would have been lost.

The habit of coming late to work is a "dead give away," on the face of it. The most regular men in some shops are those that are regularly late. They come to time, only it is not exactly the right time, as accurately as any men in the establishment; so that they show conclusively that they are perfectly able to be as punctual as any.

It may be said that it is a "give away" upon the foreman and shop authorities to allow such a habit to exist. Make stringent regulations and enforce them unflinchingly, and break it up, you say. But rules cannot be made, however sternly enforced, that will entirely cure it. Close the shop doors sharply to the minute, or close them with the same sharpness after one or two minutes of grace, and the man who hops over the threshold at the last moment does not get fairly at work for five or ten minutes. Late at morning and at noon, and averaging, to put it lightly, say five minutes a day, amounts to 2½ days in the year. There are men who would cut their right hands off before they would rob an employer of that amount "in bulk," who still think him mean and narrow if he notices the same loss when entailed in this thoughtless way. That one has to be watched to see that he does not cheat and defraud by little clippings from the amount of labor that he ostensibly sells, is not a thing to be palliated by any excuses. The only right and fair and manly way is to abandon the habit.

A gift, such as I propose, is certainly one that the foreman could welcome and appreciate. He dislikes above all things to do police duty. He feels that such is not his legitimate business. It is not in human nature that he should feel as kindly as he otherwise would toward those who force it upon him. I think the best foreman is generally kind and helpful, and he deserves a little appreciation. He is not necessarily a representative and guardian of the employer's interests alone. A faithful foreman must necessarily be faithful to both parties, and mindful of the rights of each. He carries the comfort and well-being of his men in his mind constantly, and may do and does do many things in their interest that they don't always hear about. Once, in a shop with which I have the honor to be no longer connected, they were crowding us pretty hard to get out a certain job, and I remarked to a man, that I hoped the shop would not have to run nights on it, and he said, "Well, that wouldn't make any difference to you; you wouldn't have to work." The remark betrayed a profundity of ignorance that fairly took my breath away, and I hadn't a word in reply.

This bad habit does not seem to run altogether parallel with other bad habits. There is, of course, a general presumption against the man who habitually comes late to work; but the presumption is not always borne out by the fact. One is usually valuable in the shop in some direct proportion to the interest that he takes in his work, and his punctuality is one shape that his interest will naturally assume. But occasionally you will find a man that, in all other respects, you would class among the most valuable and most reliable in the shop, who is thus afflicted.

A foreman surely appreciates a valuable workman, if anybody can. His presence helps to make it easier for the foreman all around, and the foreman dislikes to go at him

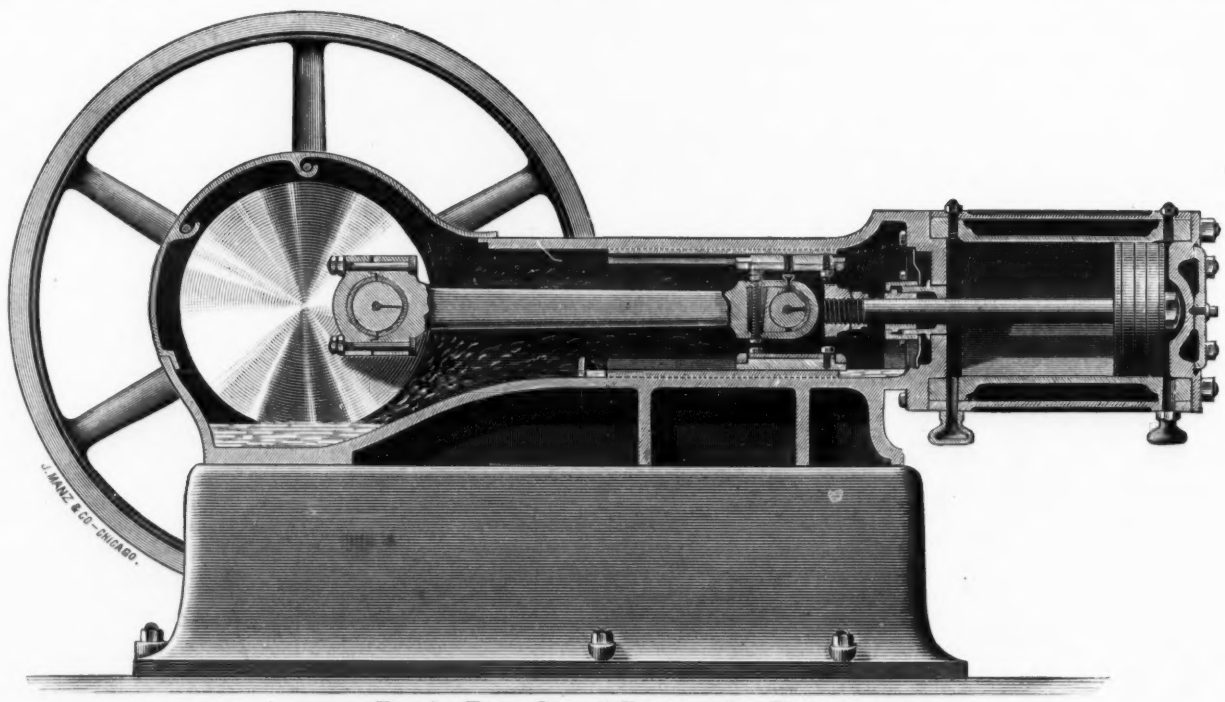


FIG. 2. THE "IDEAL" ENGINE.—SEE PAGE 1.

in a fault-finding way on any subject, and it is especially trying to have to do so upon a little thing like this. A good workman, I believe, always knows his value, and he ought to. Often he knows it a little too well for anybody's good. If he goes to presume upon it in little matters, as, for instance, in the matter of punctuality, it is not to be wondered at that it should result in strained relations.

If any apprentice or young man in the shop wants to do what he can to help himself along, and if he is so unfortunately fortunate as to be in a position to offer this little gift to the foreman that I am advocating, I do not know of anything that I could advise him to do that could take precedence of this. I don't know whether it would be formally interpreted as an expression of personal good will. I know that it would be highly appreciated as a practical embodiment of a good intention. I know that to treat any one justly is the surest way to get justice and help in return. No young fellow has any too many chances of advancement in the machine shop at the best, and he can't afford to throw any away, and that is just what he is certainly doing when he gets into the habit of coming in late to work.

This gift to the foreman must necessarily lack the element of unanimity. All cannot give it, nor, usually, can even a majority give it; for the habit to be corrected is not so wide as that. Still, curiously enough, however few may be in a position to offer the gift, they can none of them feel that in doing it they are bidding for exceptional favors. As long as the foreman is human, the existence of this bad habit in a man cannot fail to prejudice the foreman somewhat against him, and the extinction of it must be in the interest of fair play all around.

It occurs to me that, after all, this would not be a gift to the foreman alone. If any one who has any use for this little bit of advice that I have been offering, will accept it as I offer it, if they will accept it by following it, I shall feel that I have been able to bestow, in every such case, a timely and appropriate gift, and with it I have the pleasure of heartily wishing all a Happy New Year.

Practical Engine Testing.

By W. H. BOOTH.

SECOND PAPER.

Beyond the knowledge gained by a test of the amount of fuel consumed for each horse-power developed by the engine, there are many other lessons to be learned from the results of a carefully made test. Having started and finished with clean ash-pits, and newly cleaned thin fire,* the clinker and ash made during the day, as a product of a certain weight of coal, are a good indication of the purity of the fuel. Ash and clinker will vary from 5 to 12 per cent., apart from the small quantity which passes away as flue dust, and cannot be known.

Knowing the weight of water evaporated by the boiler, and there having been no blowing out, and the pressure having been carefully kept below the point at which the safety valves act, we know the actual water consumption by the engine. This, as is well known, is always greater than the amount as measured from the diagrams, and when a careful test has been made, the steam consumption should always be measured on the indicator cards, both at the point of cut-off and at a point immediately before exhaust opening. The difference between the two is, of course, the net re-evaporation during expansion, and the difference between either and the total water consumption tells the proportion of water present at the point of measurement. Thus, taken at the beginning and end of both cylinders of a compound engine, especially when there are jackets, a great amount of light is thrown on the correlation of the cylinders and the varied action of the jacket. For accurate results, the clearance at each end of the stroke—including steam passages—ought to be measured accurately, which is best done by pouring in a known weight of water to displace all air, with crank on dead points. In case of automatic variable cut-off, where a pointer shows the degree of expansion, it is possible, with a steadily loaded engine, to determine the best temperature of condenser. It is a fallacy to suppose that the final condenser temperature should be the lowest possible. In the narrower theoretical sense such may be the case, but the work in disposing of the large amount of injection water, and the vitiation of the vacuum, from the increased amount of air entering the condenser dissolved in the water together with the cooling of the cylinder, and consequent increase in initial condensation, all combine to render the economical final temperature of condenser greater than theorists would teach. As the boiler feed is usually drawn from the hot well, this is another reason for limiting the injection supply. With a pointer indicating cut-off, the condenser temperature may be varied, and the movements of the pointer noted which correspond thereto, and it is reasonable to suppose that such temperature as allows of earliest cut-off will be the best, or nearly so.

It is quite usual to test the steam supply to the engine for dryness. Such tests are usually quite useless, and even delusive, unless special precautions are taken that the steam condensed in the calorimeter is exactly of the quality actually passing through the engine.

When the steam to the calorimeter is taken out of the main steam pipe at a right angle, by a branch pipe screwed directly into it, we should expect the entrained water to be nil, and the co-efficient of dryness to be 100; for such a method would draw off dry steam, and the particles of entrained water would rush past the narrow opening of the branch pipe, without being deflected from their course. To get a true sample, the calorimeter pipe should pass into the main steam pipe at a point near the engine, and when inside, the pipe should be bent so as to present its mouth directly against the steam current, at about the middle of the main pipe's diameter.

Without an actual knowledge that some such precautions have been taken, no reliance can ever be placed on the reports of boilers, as having been proved to deliver steam of specially dry quality.

This peculiar action of a square take-off in securing dry steam has been much emphasized by the exhaust injector, which does not introduce grease into a boiler, though drawing its steam supply from a greasy engine cylinder exhaust. The particles of grease being carried by their inertia past the opening to the injector, which leaves the exhaust pipe by a squarely attached branch. Hence calorimetric reports must always be cautiously received, for they may be wholly wrong.

The writer has made many tests of steam drawn from quiet portions of boilers, with the invariable result of 100 per cent. of dryness, showing that water will not remain suspended, but soon either precipitates by gravity, or vaporizes by the absorption of heat from the water below.

No engine test is complete without it comprises tests of the vacuum in the condenser as well as in the cylinder. Blame often attaches to the condensing apparatus, which should be debited to narrow exhaust passages. Similarly, cause should be shown why the initial cylinder pressure is so much below that in the boiler, if such be the case. And, though not necessary to be taken during the test, it is always desirable that a set of diagrams should include one from the steam chest.

It is surprising how much is gained by attention to detail. Thus, simply tarring the injection pipes of an engine whose co-efficient was 16 improved the vacuum half an inch. This implied four horse-power saved, or rather produced from waste heat. In a working day of ten hours, the engine would thus save 80 pounds of coal, for it consumed at the rate of two pounds per horse-power per hour.

An annual saving of 24,000 pounds of coal may mean anything from 18 to 40 dollars, according to locality, but is a good return for the expenditure of a pailful of common tar, in stopping microscopical air inlets, the great enemies of condensation.

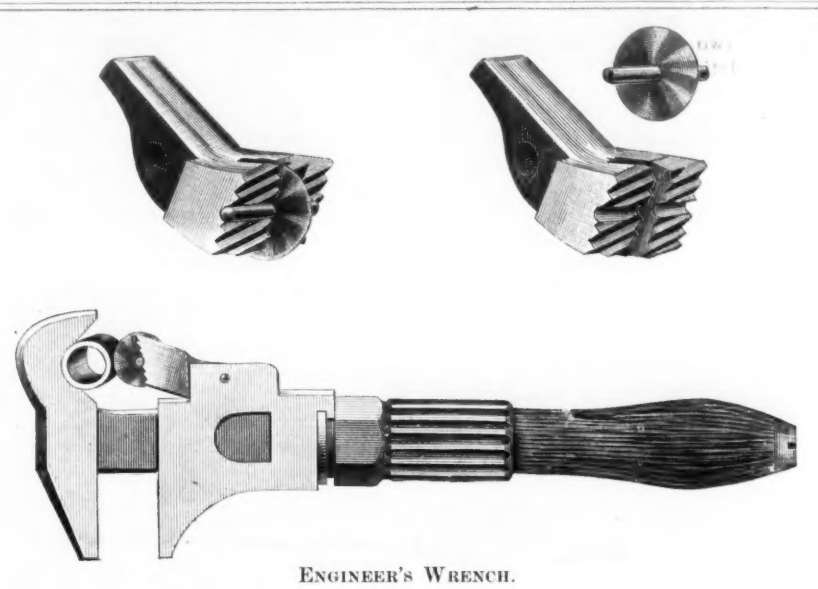
Where the load on an engine is constant, as in a cotton mill, the comparison of tests made in similar weather, so as to secure about equal temperatures, is often useful in determining the relative value of lubricating oils.

A change from one good oil to another, more or less expensive, but also good, may add or subtract five or ten per cent. of the engine power. The writer has known the admixture of a half-priced oil with a previously used expensive oil, reduce the turning power about eight per cent. The cheap oil would have been cheap had it been even more expensive than the dearer lubricant, which it partially displaced.

Practical experience shows that even lubricating oils are sometimes in need of being themselves lubricated by other oils, which have too little body to act as direct lubricants of metals.

A general advance in the wages of coal miners and iron workers has taken place recently in England.

* Where more than one boiler is used to supply steam for the engine, the equalization of fires is more difficult. If possible, it should then be arranged that the time from which the test dates is midway between the first and last furnace being cleaned.



ENGINEER'S WRENCH.

Engineer's Wrench.

The accompanying cuts show a special form of wrench, which, as it is designed particularly for use about a steam plant, is called by the makers an "Engineer's Wrench." As will readily be perceived, it is capable of performing all the functions of an ordinary monkey-wrench, in addition to which it is useful as a pipe wrench and as a pipe cutter, or can be used to cut round iron.

The cut shows it as used for cutting pipe. By the removal of the disk cutter, it becomes a pipe wrench. The uses of such a tool are too well known to need recounting here. For engineers and others having occasional pipe fitting and promiscuous work to do, and yet who are not warranted in keeping on hand a full outfit of tools for such work, this will, no doubt, prove to be well worth its cost. It is made by Tower & Lyon, 95 Chambers st., New York.

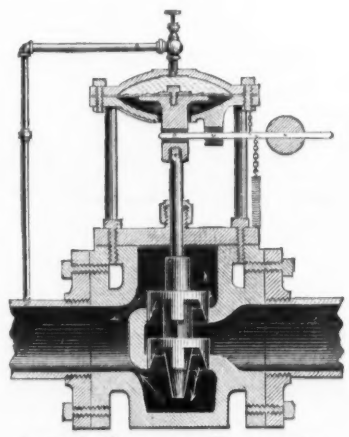
Acton's Pressure Regulator.

The accompanying illustration represents an improved pressure regulator, which has lately been perfected and placed on the market. It is equally well adapted for steam, water, or any other liquid which may flow through the device. The illustration represents the regulator as arranged for the reduction and even maintenance of the pressure in the discharge pipe, which is shown on the left hand side, regardless of the initial pressure in the supply pipe, which is shown on the right hand side. The construction of the regulator can be described as follows:

The stem of the balanced piston valve bears against the underside of the diaphragm, which divides the surrounding casing of the latter into two compartments. The lower one is in communication with the atmosphere, and the upper one is in communication with the discharge pipe, consequently the pressure above the diaphragm will be equal to that in the discharge pipe. The amount to which the pressure is to be reduced is fixed by the weight on the lever, which is placed under the diaphragm casing. The spring below this lever is mainly for the purpose of preventing jerks in the motion of the lever and weight while these are in action. The proportions of this spring and its chain are such that in shortening the distance between the lever and spring, by hooking up the chain on its different links in succession, the tension of the spring will, at each step, be increased ten pounds. With this arrangement, the amount of the reduction in pressure can be regulated without the weight on the lever. But the inventor claims that the best results will be secured with the use of the weight.

The small chain above the lever is simply for the purpose of preventing the weight from falling, in case the diaphragm should break, which may occur through long and continued usage. With this arrangement the regulator can be kept temporarily at work during the time in which the diaphragm is being replaced.

It will be seen that all the parts are easy of access, are not liable to be deranged or get out of order, and the amount of reduction of the pressure can readily be affected. A number of these regulators are in use, and it is claimed that they give good satisfaction. They are well adapted for hydraulic elevators, will prevent jerks, and promote smooth running. In attaching these regulators to fire hose, the danger of bursting the latter will be greatly lessened, if not altogether avoided. The device is patented and manufactured by John Acton, Franklin and Centre streets, New York City.



ACTON'S PRESSURE REGULATOR.

There is reason to believe that the coming Paris Exposition will be something beyond anything yet seen in the way of a world's fair. Nations, like individuals, learn by experience, and if this exhibition is not in advance of any that have preceded it, then Frenchmen are not as smart as they are credited with being. There are 75,000 square feet of space allotted to America, and we hope it will be filled in a manner creditable to the country.

Crystallization and Shrinkage of Cast-Iron.

BY S. BOLLAND.

SECOND PAPER.

As previously stated, this tendency to fracture in irregularly shaped castings can be considerably modified by a judicious selection of brands of iron having the least shrinkage. Broadly stated, grey iron shrinks the least; a perceptible increase of this quality manifesting itself all through the respective grades up to white iron, which is supposed to shrink the most. But it must be borne in mind that, accepting the numbers of iron as graded at the different blast furnaces, and basing our estimate of shrinkage on such grading, will oftener than not be found to be delusive, it being no uncommon thing to find No. 2 of one brand to shrink less than No. 1 of another. It would seem best, under such conflicting circumstances, to cast test bars of the several brands, and carefully note the shrinkage in each; such bars can also be tested for any other particular quality needed to bring the casting up to the required degree of perfection. This method enables the founder to combine the several qualities required with almost absolute certainty.

Contraction is a subject which causes no small amount of anxiety to the founder, owing largely to the fact that little importance is attached to it by the designer or pattern maker, who often insist upon having work made true to pattern, regardless of the obstacles they may have placed in the way of its accomplishment. Admitting the fact that some attention should be paid to symmetry of design, yet we insist that this reason should never be allowed to usurp the place of strength and safety, as is too often the case. Many instances might be quoted, where gross violations of the laws governing contraction are insisted upon, giving rise to all manner of contrivances to counteract the evil, much of which might be saved by a slight increase or decrease in the thickness of some particular part of the casting, to ensure uniform cooling of all its parts.

It has often been said that, if all the parts of a casting were made equal in thickness, there would be no trouble; but this assertion can be successfully combated by most founders of ordinary experience. Take the case of a flooring plate, say ½ inch thick and 4 feet square, carefully moulded, and cast so that no part of the casting shall deviate from the thickness specified. Does such a casting, if left to take its own course, always come out true? Hardly ever. This is only one of many instances which might be quoted to disprove such an assertion.

Let us take into consideration what takes place immediately after such a plate is cast. First, the surface under and over, as well as along the edges, almost instantly chills, from contact with the cold, damp sand; especially is this the case at the outer edges, which rapidly cool and contract, and, owing to the fact that the contraction must cease as the parts become cold, the outer portions cooling first, as just explained, are subjected to a continuous strain until the whole becomes cold and contraction ceases all over. Now, if this strain were equal on both sides, the plate would remain straight; but such is not the case; the top cools first, on account of the heat passing more rapidly through the cope than it does into the floor, leaving the under surface to contract last, which it of course does by drawing the corners down, or, as is frequently the case, breaking the plate.

The lines of weakness shown in the solids are also lines of weakness in the plate, because, being the last to cool, the crystals assume larger dimensions, with a corresponding diminution in density, which means a loss of strength. To counteract this tendency to warping in plates, such as we have under consideration, cooling must be urged at such parts as would be last to set, so that equal rates of contraction may ensue. The parts which cool last in this case are indicated by the diagonals in the end section of Fig. 3; and should the plate be oblong, they will be as shown at end section of Fig. 12. By uncovering the sand from these parts immediately after pouring, taking care to keep the outer edge well protected from the cold air, we may expect a true casting in most cases.

We will now look for a remedy in this case, that will not only save all the annoyance and trouble of cooling after the plate is cast, but will give us a casting comparatively free from internal strains.

We say the outer edge cools too quick; then increase the body of metal at that part. We say likewise that the diagonals cool too slow; then reduce the body of metal at that part sufficient to counteract the evil.

By adding ⅛ of an inch to the thickness at the edges, two inches wide, chamfered so as to lose itself gradually in the surface, as shown in section at Fig. 13, and reducing the thickness at the diagonals $\frac{1}{16}$ of an inch, working this out in every direction evenly and without abruptness, as shown by the rays in plan Fig. 13, the difficulty is surmounted.

Round disks or plates may be treated similarly. Should the plate be required four feet in diameter and ½ inch thick, let the edge be $\frac{9}{16}$" thick, two inches wide all round, gradually reducing to $\frac{7}{16}$" in the center.

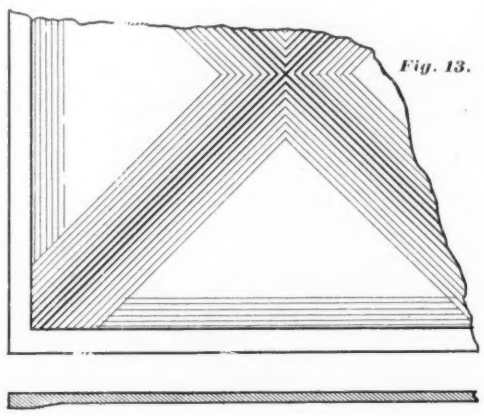


Fig. 13.

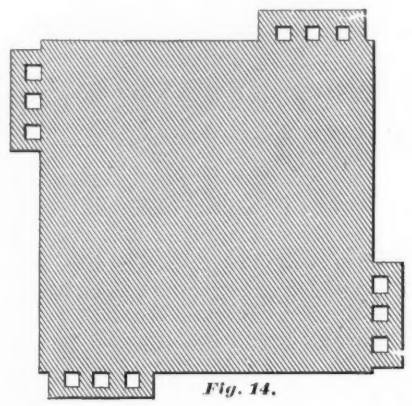


Fig. 14.

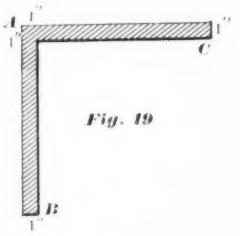


Fig. 19

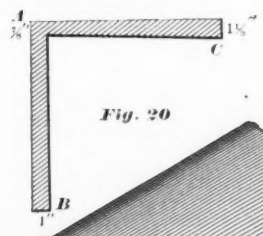


Fig. 20

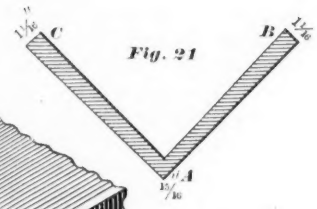


Fig. 21

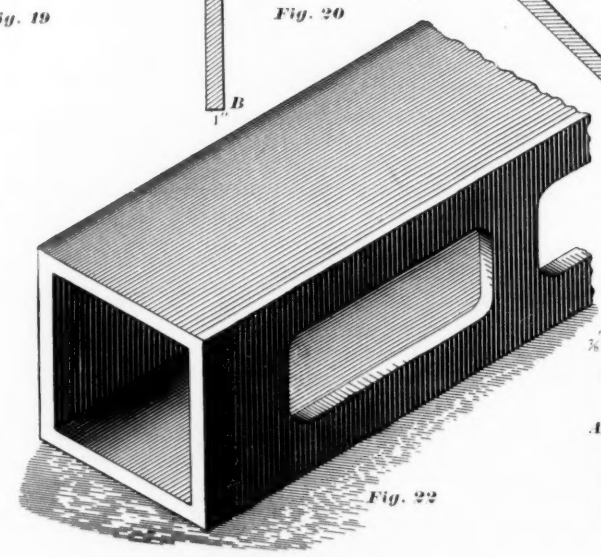


Fig. 22

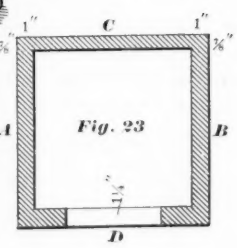


Fig. 23

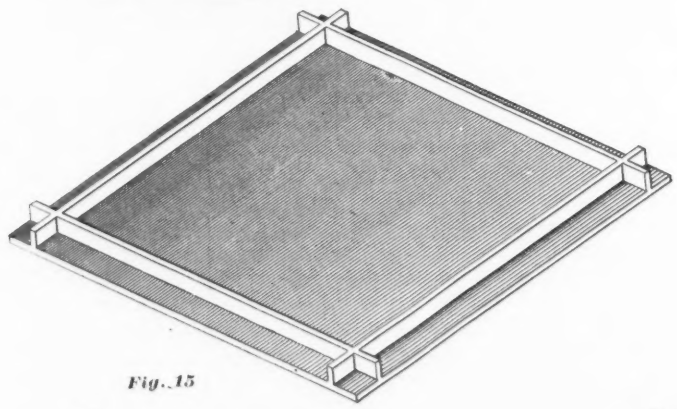


Fig. 15

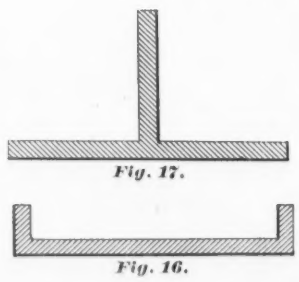


Fig. 17.

Fig. 16.

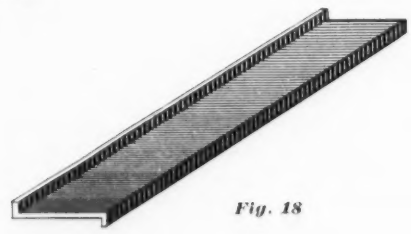


Fig. 18

The proportions given will answer in the majority of cases for all such castings as we have been describing.

To ensure good work of this kind, hot iron and rapid filling of the mould is indispensable. An arrangement of the gates for pouring large plates is shown at Fig. 14, which, when practicable, it is always best to adopt; for, by the time the metal entering each gate has reached the opposite side, much of its heat has been absorbed by the cold mould, but it here receives an impetus from the hot iron which is just entering the mould at that spot. The metal, by this method of pouring, is given a rapid circular motion, which ensures the correct filling of the mould with well-mixed iron at a uniform temperature; a desideratum in this instance; for, as before stated, difference in temperature causes variations in shrinkage.

When ribs the same thickness as the plate are cast on, as shown at Fig. 15, the casting will be hollow on the plain side; the reason for which is, that the edges of the ribs set and contract, whilst the metal, at their junction with the body of the plate, is in a plastic condition. These edges then act as a prop or stay, to prevent the plain side from shrinking in a straight line; it must consequently either bend or break, the latter thing occurring very frequently.

If the outer edge be increased in thickness, as before directed, and the ribs made one-fourth thicker than the body of the plate, this difficulty will be obviated.

Long plates, as shown in section at Fig. 16, always give trouble if ribs and plate are equal in thickness; by increasing the thickness of the ribs one-fourth, straight castings will result. Suppose the plate at Fig. 16 be ¼ inch, then the ribs would require to be $\frac{5}{16}$ inch.

Beams similar to section Fig. 17 are always hollow on the plate side if the web is made the same thickness as the plate; the remedy suggested above will ensure success in this case.

Fig. 18 shows a casting having one rib on each face at opposite edges; when such castings are made equal in thickness all over, the plate will be drawn convex along one edge and concave at the other. To put it another way, both ribs will be down at the ends. The remedy in this case is to increase the quantity of metal in the ribs 25 per cent., as before.

Fig. 19 is the sectional elevation of a casting, large numbers of which are made of various lengths in the several architectural works, for building purposes. The tendency in such castings is to warp hollow along the angle *A*. This is caused by unequal cooling; *B* and *C* cool first, and act as stays to prevent the part *A*, which is last to cool, from shrinking in a straight line. The edges *B* and *C* are consequently drawn round. It is customary to bare these castings along the angle *A* as soon as cast, with the view of preventing this; but this method rarely meets the case. A slight change in the form is all that is needed to obviate this trouble. Suppose the casting to be 1 inch all through in the original, as at Fig. 19; the alteration suggested is shown at Fig 20 (when the casting must be moulded in the position as seen). The horizontal web is 1⅛ inches at *C*, and ⅞ inch at *A*, the vertical web being 1 inch all through in the pattern; this web will increase some in thickness at *B*, being the point of greatest pressure when cast. Consequently we have a gradual increase of thickness extending outwards, with a corresponding decrease at the junction of the webs at *A*.

When such castings can be moulded in the position seen at Fig. 21, the dimensions must be as figured, $1\frac{5}{16}$ inch at *A*, and $1\frac{1}{16}$ inch at *B* and *C* respectively. Square columns, with openings along one side, shown at Fig. 22, if cast say 1 inch thick all over, will in all cases be drawn hollow on the side which is opposite to the holes, if left to take their own course after being cast. The best method of bringing these columns out straight is to so proportion the thickness on all the sides as to produce equal rates of cooling. Fig. 23 is a section of 12-inch column, with figures showing the requisite proportions when the average thickness is to be 1 inch. Sides, at *A B*, 1 inch; top *C*, ⅞ inch; bottom *D*, 1¼ inch.

Trade between Mexico and the United States is steadily increasing. Machinery and household articles are in demand in Mexico.

Modern Locomotive Construction.

BY J. G. A. MEYER.

EIGHTY-FIRST PAPER.

In our last paper it was seen that there are many causes which at any time may increase the stress on a side rod, and may increase it to such an extent, which will cause fracture of, or injury to the rod. The total stress to which the side rods may at any time be subjected, can only be determined by experience and close observation of the behavior of the side rods in every-day service, and facts obtained in this way will enable us to establish rules for guidance in designing other side rods for similar locomotives. The following rules are empirical, and will hold true only within the limits of ordinary locomotive practice.

In eight-wheeled passenger engines, the side rods are longer than those used in consolidation engines; and since the length of the rods has an important bearing upon the size of the cross-section, that is to say, for longer rods we require a greater cross-section, it follows that the side rods for consolidation engines have generally a smaller cross-section than that of the rods for passenger engines, diameter of cylinders, and maximum steam pressure being the same in both cases. Again, in consolidation engines the front and rear side rods have less work to do than the central side rod, and therefore the cross-section of the latter rod is generally made greater than that of the front and rear rods.

In mogul, and ten-wheeled engines, the length of the rear side rods is generally equal to the length of the side rods in passenger engines of the same power; but the front side rods in the former classes of engines are generally shorter, and therefore the cross-sectional area of the front rods is often made less than that of the rear side rods. Yet this is not a universal practice, as in these classes of engines we meet with many in which all the side rods are of equal cross-section. Similar remarks apply to consolidation engines; that is to say, in a number of engines of this class, there is no difference made in the cross-sectional area of the side rods, whereas in others the cross-sectional areas for the front and rear side rods are made less than that of the central rods.

Here, then, we see that practice differs, and therefore, in establishing our rules, we shall follow the average of good practice.

Side rods of uniform rectangular cross-section for eight-wheeled passenger engines. In comparing the side and main rods made by different builders, we find that cross-sectional area of the side rods is generally about ten per cent. less than the cross-section at the smallest part of the main rod. Consequently, to find the cross-section of side rods for passenger engines, we have the following rule:

Rule 65. Divide the total maximum steam pressure on the piston by 5,500; the quotient will be the number of square inches in the cross-sectional area of the side rod for eight-wheeled passenger engines.

Example 98. In a passenger engine, having cylinders 18 inches in diameter, the maximum steam pressure on the piston is 140 pounds per square inch; what should be the cross-sectional area of the side rod?

The total maximum steam pressure on the piston is

$254.47 \times 140 = 35{,}625.8$ pounds,

and $\frac{35{,}625.8}{5{,}500} = 6.47$ square inches in the cross-sectional area of the side rod.

In practice a difference exists between the ratio of the thickness to depth of the side rods, but observation indicates that two and a half times the thickness for the depth is a good proportion; and this we shall adopt for side rods in passenger engines. Hence we have the following rule:

Rule 66. To find the thickness and depth of side rods for passenger engines. Multiply the cross-sectional area of the side rod (as found by Rule 65) by 2, and divide the product by 5; the square root of this quotient will be the thickness. The product obtained by multiplying the thickness by $2\frac{1}{2}$ will be the depth of the side rod.

Example 99. Find the thickness and depth for a side rod for an eight-wheeled passenger engine with cylinder 17 inches diameter; maximum steam pressure on the piston 150 pounds per square inch.

The total maximum steam pressure on the piston is $226.98 \times 150 = 34{,}047$ pounds. According to Rule 65, the cross-sectional area of the side rod should be

$$\frac{34{,}047}{5{,}500} = 6.19 \text{ square inches.}$$

According to Rule 66, the thickness of the side rod should be

$$\sqrt{\frac{6.19 \times 2}{5}} = 1.57 \text{ inch} = 1\tfrac{9}{16} \text{ inch nearly.}$$

And the depth should be

$1.57 \times 2.5 = 3.92$ inches $= 3\frac{15}{16}$ inches nearly. Hence the side rod should be $1\frac{9}{16}$ inch thick, and $3\frac{15}{16}$ inches deep.

The foregoing rules will only hold true for side rods made of the best quality of hammered iron, whose lengths for 9″, 10″ and 11″ cylinders do not exceed 6 feet 6 inches; for 12″, 13″, 14″ cylinders, 7 feet 6 inches; for 15″, 16″, 17″ cylinders, 8 feet 6 inches; and for cylinders 18 inches diameter and upwards, 8 feet 9 inches. For shorter rods in this class of engines, the cross-sectional area could be somewhat reduced; but for the sake of uniformity of templates, etc., such close adjustment of the cross-sectional area to the length of the side rod is not usually observed.

The appended tables have been arranged by the foregoing rules.

Side rods for mogul and ten-wheeled engines. From what has been said in the beginning of this article, it will be seen that the dimensions of the side rods given in the following tables can be used for the rear side rods in mogul, and also for the rear side rods in ten-wheeled engines. And since the front side rods in these classes of engines are shorter than the rear ones, we believe it to be good practice to reduce the cross-sectional area of the front rods. In nearly all mogul and ten-wheeled engines, the thickness of the rear side rods is equal to the thickness of the front ones; consequently, when we wish to reduce the cross-sectional area of the front rods, we have only to reduce their depth, according to the following rule.

Rule 67. To find the depth for the front side rod. Multiply the depth of the rear side rod (taken from the foregoing tables) by .08; and subtract the product from the depth of the rear side rod; the remainder will be the depth of the front rod.

Example 100. What should be the dimensions of the cross-section for a front side rod in a mogul engine, having cylinders 18 inches diameter, maximum steam pressure on the piston 140 per square inch?

Looking in Table H, we find that for a cylinder 18 inches diameter, the rear side rod should be $1\frac{1}{8}$ thick, and 4 inches deep. Since the thickness of the rods is not changed, we know that the thickness of the front side rod should be $1\frac{1}{8}$ inch. According to Rule 67, the depth of the front rod should be equal to 4 inches $- (4 \times .08) = 3.68$, say $3\frac{3}{8}$ inches.

TABLE F.

THICKNESS AND DEPTH OF SIDE RODS OF UNIFORM RECTANGULAR CROSS-SECTION, MADE OF THE BEST HAMMERED IRON, FOR EIGHT-WHEELED PASSENGER ENGINES. MAXIMUM STEAM PRESSURE ON THE PISTON, 120 POUNDS PER SQUARE INCH.

Diam. of Cylind'rs.	Thickness.	Depth.
9″	$\frac{3}{4}$″	$1\frac{7}{8}$″
10″	$\frac{13}{16}$″	$2\frac{1}{16}$″
11″	$\frac{13}{16}$″	$2\frac{1}{4}$″
12″	1″	$2\frac{7}{16}$″
13″	$1\frac{1}{16}$″	$2\frac{11}{16}$″
14″	$1\frac{1}{8}$″	$2\frac{7}{8}$″
15″	$1\frac{1}{4}$″	$3\frac{1}{16}$″
16″	$1\frac{5}{16}$″	$3\frac{5}{16}$″
17″	$1\frac{5}{16}$″	$3\frac{1}{2}$″
18″	$1\frac{1}{2}$″	$3\frac{11}{16}$″
19″	$1\frac{9}{16}$″	$3\frac{15}{16}$″
20″	$1\frac{5}{8}$″	$4\frac{1}{16}$″
21″	$1\frac{3}{4}$″	$4\frac{5}{16}$″
22″	$1\frac{13}{16}$″	$4\frac{1}{2}$″

TABLE G.

THICKNESS AND DEPTH OF SIDE RODS OF UNIFORM RECTANGULAR CROSS-SECTION, MADE OF THE BEST HAMMERED IRON, FOR EIGHT-WHEELED PASSENGER ENGINES. MAXIMUM STEAM PRESSURE ON THE PISTON, 130 POUNDS PER SQUARE INCH.

Diam. of Cylind'rs.	Thickness.	Depth.
9″	$\frac{13}{16}$″	$1\frac{15}{16}$″
10″	$\frac{7}{8}$″	$2\frac{1}{16}$″
11″	$\frac{7}{8}$″	$2\frac{3}{16}$″
12″	$\frac{15}{16}$″	$2\frac{3}{8}$″
13″	1″	$2\frac{9}{16}$″
14″	$1\frac{1}{16}$″	$2\frac{3}{4}$″
15″	$1\frac{1}{8}$″	3″
16″	$1\frac{3}{16}$″	$3\frac{1}{16}$″
17″	$1\frac{1}{4}$″	$3\frac{5}{16}$″
18″	$1\frac{5}{16}$″	$3\frac{7}{16}$″
19″	$1\frac{3}{8}$″	$3\frac{5}{8}$″
20″	$1\frac{7}{16}$″	$3\frac{7}{8}$″
21″	$1\frac{1}{2}$″	$4\frac{1}{16}$″
22″	$1\frac{9}{16}$″	$4\frac{3}{16}$″

TABLE H.

THICKNESS AND DEPTH OF SIDE RODS OF UNIFORM RECTANGULAR CROSS-SECTION, MADE OF THE BEST HAMMERED IRON, FOR EIGHT-WHEELED PASSENGER ENGINES. MAXIMUM STEAM PRESSURE ON THE PISTON, 140 POUNDS PER SQUARE INCH.

Diam. of Cylind'rs.	Thickness.	Depth.
9″	$\frac{13}{16}$″	2″
10″	$\frac{7}{8}$″	$2\frac{3}{16}$″
11″	$\frac{15}{16}$″	$2\frac{7}{16}$″
12″	$1\frac{1}{16}$″	$2\frac{5}{8}$″
13″	$1\frac{1}{8}$″	$2\frac{7}{8}$″
14″	$1\frac{1}{4}$″	$3\frac{1}{16}$″
15″	$1\frac{5}{16}$″	$3\frac{5}{16}$″
16″	$1\frac{7}{16}$″	$3\frac{9}{16}$″
17″	$1\frac{1}{2}$″	$3\frac{3}{4}$″
18″	$1\frac{5}{8}$″	4″
19″	$1\frac{11}{16}$″	$4\frac{1}{4}$″
20″	$1\frac{3}{4}$″	$4\frac{1}{2}$″
21″	$1\frac{7}{8}$″	$4\frac{11}{16}$″
22″	2″	$4\frac{15}{16}$″

TABLE I.

THICKNESS AND DEPTH OF SIDE RODS OF UNIFORM RECTANGULAR CROSS-SECTION, MADE OF THE BEST HAMMERED IRON, FOR EIGHT-WHEELED PASSENGER ENGINES. MAXIMUM STEAM PRESSURE ON THE PISTON, 150 POUNDS PER SQUARE INCH.

Diam. of Cylind'rs.	Thickness.	Depth.
9″	$\frac{13}{16}$″	$2\frac{1}{16}$″
10″	$\frac{15}{16}$″	$2\frac{5}{16}$″
11″	1″	$2\frac{1}{2}$″
12″	$1\frac{1}{16}$″	$2\frac{3}{4}$″
13″	$1\frac{1}{8}$″	3″
14″	$1\frac{3}{16}$″	$3\frac{1}{4}$″
15″	$1\frac{3}{8}$″	$3\frac{7}{16}$″
16″	$1\frac{7}{16}$″	$3\frac{11}{16}$″
17″	$1\frac{1}{2}$″	$3\frac{15}{16}$″
18″	$1\frac{5}{8}$″	$4\frac{1}{16}$″
19″	$1\frac{3}{4}$″	$4\frac{5}{16}$″
20″	$1\frac{13}{16}$″	$4\frac{5}{8}$″
21″	$1\frac{15}{16}$″	$4\frac{7}{8}$″
22″	2″	$5\frac{1}{16}$″

TABLE J.

THICKNESS AND DEPTH OF SIDE RODS OF UNIFORM RECTANGULAR CROSS-SECTION, MADE OF THE BEST HAMMERED IRON, FOR EIGHT-WHEELED PASSENGER ENGINES. MAXIMUM STEAM PRESSURE ON THE PISTON, 160 POUNDS PER SQUARE INCH.

Diam. of Cylind'rs.	Thickness.	Depth.
9″	$\frac{7}{8}$″	$2\frac{1}{8}$″
10″	$\frac{15}{16}$″	$2\frac{3}{8}$″
11″	$1\frac{1}{16}$″	$2\frac{5}{8}$″
12″	$1\frac{1}{8}$″	$2\frac{7}{8}$″
13″	$1\frac{1}{4}$″	$3\frac{1}{16}$″
14″	$1\frac{5}{16}$″	$3\frac{5}{16}$″
15″	$1\frac{7}{16}$″	$3\frac{9}{16}$″
16″	$1\frac{1}{2}$″	$3\frac{13}{16}$″
17″	$1\frac{5}{8}$″	$4\frac{1}{16}$″
18″	$1\frac{3}{4}$″	$4\frac{5}{16}$″
19″	$1\frac{13}{16}$″	$4\frac{1}{2}$″
20″	$1\frac{15}{16}$″	$4\frac{3}{4}$″
21″	2″	5″
22″	$2\frac{1}{16}$″	$5\frac{1}{4}$″

Power from the Waves.

Many a visitor to the Cliff House has wondered what the spidery-looking contrivance is for, that they have seen a few hundred yards up the beach at Point Lobos. If they will go up to it now and make inquiries, for it is at last in working order, they will find that it is a machine for turning the rhythmical beating of the waves against the rocks into power that can be utilized for working mills and manufactories, and driving cable cars and putting salt water baths into city houses, and sprinkling the streets and flushing the sewers. Though the result of supplying a power that can take the place of high-priced coal is so important, the machinery by which it is accomplished is simple enough. One wonders, as soon as he sees it, why somebody didn't think of it ages ago.

All that there is of it is a sort of developed suction pump, in which the power is supplied by the waves, a reservoir, and water wheels. Suspended from big iron uprights is a framework, across the lower part of which is fastened heavy planking. This planking presents a face to the waves about 6 x 12 feet, and its framework is so arranged that it can be raised or lowered, as the tide rises and falls. The waves, dashing against this, move it in iron grooves backward and forward, and its motion is communicated through some other machinery to a 12-inch piston, so that a movement of 32 feet by the framework causes a 9-foot movement of the piston. This pump connects with a long suction pipe, the other end of which is under water. This pipe is fitted with a screen to keep out sand and débris. An air chamber, 14 feet high, keeps the pressure in the pump steady, and forces a constant stream of water through the pipe that clambers up the cliff and over the hill to a height of 150 feet. That is as high as the pipe goes now, but the force is sufficient to pump the water a height of 500 feet above sea level. The remainder of the plan is a huge reservoir at that height, and system of water wheels, which would supply power limited only by the number of motors.

After the water has passed over the water wheels, it is the idea of the company that it could be brought into the city and used for private baths, street sprinkling, sewer flushing, and other things. At present the motor only is completed, and the water pumped up is allowed to run off in the ground.

Only one piston has been put in as yet, but this pumps at the rate of three barrels per minute, and the motor could drive also four others of equal capacity.

The force, of course, increases as the tide rises and as the wind sets in towards the land. Ordinarily the motor does not work at low tide, but will run usually from eighteen to twenty hours per day, and under favoring conditions of wind and tide will work steadily the whole twenty-four.

This motor was begun about three years ago, but unfortunate circumstances have delayed its completion. Severe storms have several times thrown the work back, and when the dynamite-loaded schooner exploded off Point Lobos, the rock upon which it was being built was split in two. It has only just been completed, but so far has worked with complete success.—*San Francisco Examiner.*

The Modern Steam Plant and Its Management.

BY PETER H. BULLOCK.

THE BOILER ROOM.

The title of this paper will call to the minds of different persons very different appearing places. It may be a lofty structure wherein are set, in the best manner, boilers aggregating hundreds of horse-power; or it may be a low, dark corner in the basement of some building where a pit has been dug for the furnace, and the safety valve squeezed up against a floor, giving it little chance to gratify its natural inclination to rise and sing. But be the surroundings grand or mean, here will be found going on, under various degrees of economy, the combustion of fuel in or under boilers;

and by the utilization of a part of the heat resulting therefrom, water is evaporated into steam with the same uncertain degree of economy as attended the combustion of the fuel to produce it.

It will be admitted by all, that the first requisite after safety is economy in operating a boiler plant, and the economies I will divide into two classes, namely, the direct and indirect. Under the first come the facts and details of combustion, the loss from radiation, the quality of the feed water, the possession of apparatus for regulating the pressure and for utilizing the heat of the gases in the flue. Under the latter head come such items as proper conveniences for handling the fuel and ashes, the use of labor-saving devices and instruments for testing temperatures, both of feed water and furnace gases, and numerous other small things, the use of which is at all times desirable, and frequently absolutely necessary.

In treating of the boiler room, I will consider that by itself, and see about the steam produced by the combustion of the fuel, regardless of how it will be used when it gets to the engine room. As what pertains to the combustion and the care of the furnace has the most to do with direct economy, I will notice that first, and consider the furnace as a mill into which we put raw material (fuel), and which produces steam from the boiler with good or poor results, dependent upon the direct and indirect causes, as before mentioned. In order to produce the best results, we must take advantage of all the methods and improvements that the experience of our predecessors have proved to be desirable, and which our own good sense convinces us to be so. We will therefore glance back a little to the changes that have taken place during the last twenty years.

Although during that time there has been no radical change in the shape or style of boiler setting, still there have been very decided improvements, and the best practice of to-day differs very much from that time. These changes have been quite largely in the direction of higher furnace temperatures, with more fuel burned per square foot of grate per hour, than formerly, and the introduction of appliances for promoting the combustion of the gases at or near the bridge wall. The distance of the grate from the shell or crown sheet has been largely increased, and with good results. I call to mind a set of ten boilers erected some eighteen years ago, with but 16 inches between the grate and shell, while the same furnaces would now be given from 20 to 30 inches by different builders. It was also a custom to build the bridge wall on a curve corresponding with the shell of the boiler, and frequently but 4 or 5 inches away. This caused the flame and most intense heat to impinge on the shell at that point, and fractured fire sheets were frequently the result. It is now more generally the custom to leave the bridge straight across, or else to divide the curve between a straight line and the sweep of the boiler, the former being the most convenient to get over for inspection, and the latter, provided there is at least 8 or 10 inches between the wall and shell at the center, is probably the best, from the fact that it better ties and supports the side walls.

My own experience has led me to believe that the bridge is only necessary for the latter purpose, as a limit to the fire, and a convenient point to introduce fresh air to complete the combustion of the gases. Quite likely, this statement will not agree with the opinions of many, but it is the result of experiments, lasting over a year, with different shapes of furnaces, bridge walls and combustion chambers.

In regard to the latter, there seems to be no accepted style, different builders setting their boilers according to some freak of fancy or custom; and, as a matter of fact, it makes little difference what the style is, so long as it leaves them accessible for inspection. In the experiments before referred to, it was found that a filling even with the bridge clear back to the end of the boiler raised the temperature in the tubes and up-take, showing that less heat was taken up by the shell in the quicker passage of the gases than where they were allowed to expand and mingle in a larger space. There is another loss from a too close passage from the bridge to the tube ends, by more of the soot and fine ashes being carried with the strong current and deposited in the tubes. This is largely avoided by leaving a larger space back of the wall, where, owing to the currents being broken up and eddies formed, most of the solids will be deposited, instead of passing on and entering the tubes.

Most of the foregoing relates principally to shell boilers and their setting. In the class known as sectional, the improvements have mostly been to the boilers, in reducing the number of joints and avoiding the exposure of them to the fire; also in substituting wrought-iron or steel tubes in the place of cast-iron, for the principal heating surfaces. There is one fact that should be placed to the credit of the sectional boiler builders, and that is that their furnaces have uniformly been better designed and constructed than have those under shell boilers. The inclined position of the tubes that are generally to be found in sectional boilers, has, however, given more room for the furnace than can be had under a shell, which opportunity is probably largely the cause of the better form usually found in them than in the latter class.

It is my claim that not a few of the grey hairs that adorn my head are the result of the anxiety and fear of trouble I underwent some twenty years ago, regarding a sectional cast-iron boiler, the globular parts of which were wont to let go, much to the disturbance of my peace of mind, and whose joints were in a chronic state of leakage. The theory of the "survival of the fittest" has partially atoned for my premature bleaching, and engineers have nothing to fear from the most excellent sectional boilers now in the market.

In the next chapter we will start up a fire and raise a little steam.

LETTERS FROM PRACTICAL MEN.

"Thinking and Wages."

Editor American Machinist:

While I do not care to enter into a controversy with T. A. Pandie, on the question of "Thinking and Wages," I do feel justified in replying to his letter, questioning the ground I take, as stated in the paragraph published in your Dec. 1st number, and I do this because he has misinterpreted my meaning and extended the scope of the question, although to that I take no exception.

The position I take, stated in its plainest terms, is this: That of two young men of equal natural ability and equal advantages, one may succeed and the other fail, and a key or index of their success or failure may be found in the fact that one thinks of his work and the other of his wages. I do not say, neither do I doubt, that the one who thinks of his wages is more likely to get what he is worth than the other. In fact, I believe the one who thinks of his wages will get all he is worth, *which will never be much;* while the one who thinks of his work, may not get one-half he is worth, it will still be *twice that of his competitor.*

It is not unreasonable to infer that T. A. Pandie is one who thinks about his work, and thinks hard. I would kindly ask him to look back to his apprenticeship days and trace out the history of those of his associates who started in at the same time and under like advantages (among whom he will likely find many less successful than himself and a few more so), and note among which set he finds those who were enthusiasts at the business.

Taking into consideration T. A. Pandie's ground about the "many looking after their wages," while this is an extension, if not a different subject, I am willing to meet it by admitting that it is all right, and have only to add that those who are constantly looking for the highest wages never some way seem to get them.

Another point: the wife and children question. My observation has led me to observe that the wife and children of the carpenter who lays still all summer because he cannot get $3.00 a day, and works all winter at $2.50, do not fare much better than the laborer's wife and children, even if he only gets $1.25 the year round.

For the manufacturer to sell his goods and the workman his labor at the highest price are both right and proper; but when it costs 25 cents to get the advance of 10 cents, the luxury is likely to slumber in the left-hand pocket.

While there are unfair as well as liberal employers, or, let us admit, a good many niggardly to the few generous ones, the employe who imagines that the employer will never find out his worth until he tells him of it, is quite likely to be mistaken. A good many employers have learned that it is sound business policy to raise a man's wages ten cents a day before he asks for twenty-five.

J. G. TRAMIS.

Covering for Pipes—Mental Processes.

Editor American Machinist:

I notice in a recent issue a recipe for pipe covering composed of sawdust and starch. An old French recipe is sawdust and flour, which is practically the same thing, only cheaper. It is a good non-conductor, too. It sticks very well and is easy for anyone to get and apply.

A gentleman asked the writer what was the best thing to cover his hot air flues from his furnace in the cellar with, so as not to keep his cellar too warm, and he was advised to get mineral wool; but he thought that cost too much, and not quite liking the idea of coal ashes, plaster of paris and flour, and giving the assurance that it was not the smoke pipe from furnace to chimney that he wanted covered, that the pipes named were no hotter than ordinary steam pipes, he was advised to put on sawdust and flour, which he did.

After it had become dry, it took fire, and but for its timely discovery, would have burned his house down.

It was removed and used for kindling wood. He said it made a splendid fire, and his family were sorry when it was gone.

On steam pipes it chars, and is not more durable than hair felt, while the danger from fire is greater.

Any simple process by which mental work may be easier done is usually worth remembering; and there is a peculiarity about all numbers ending in 5 that makes the squaring of that number easy. Suppose we want to square 65, we can do it mentally as follows:

Imagine the example set as is usual in multiplication:

$$\begin{array}{r} 65 \\ 65 \\ \hline 4{,}225 \end{array}$$

and we say $5 \times 5 = 25$. Set the 25 down under the unit column, then add 1 to the 10 column, and say: $7 \times 6 = 42$, and set that down; we then have the answer, 4,225 as the square of 65. The square can be found in this manner with any number ending in 5, but with no other number.

In finding the area of a number mentally, .7854 is very nearly 2 per cent less than .8, and we can multiply the square by .8 and subtract 2 per cent.

W. E. CRANE.

Is the Contract System a Failure?

Editor American Machinist:

The title refers to the system which has been for a long time popular in manufacturing establishments, of giving out work to a "contractor" in the shop, at a certain price, at which the contractor makes as much as he can, or sometimes loses, as the case may be. It is different from piece-work, because the contractor has one or more men or boys working under him, whose wages he (the contractor) pays, so that he is, to a certain extent, an employer.

The question is whether or not this manner of producing work is, at the present time, best for the principal parties concerned: *i. e.* the proprietor and the contractor.

The question of the workmen and piece-work seems to be a separate one, and need not be considered here, although I would say incidentally, that a man of long experience, who is looked up to by a large part of the mechanical world as leading authority on such matters, lately said that the whole piece-work system (which really includes the contract system, although the contract system does not necessarily include the other,) is a flat failure.

One of the many ethical wrongs of the contract system has been (I say "has been" because the system is rapidly being superseded everywhere), that it has placed no premium on mechanical culture; shop proprietors seem to have been willing to give contracts to a class of men whom they would never think of employing as foremen or superintendents of the same work, at half the amount of money as salary, that is made as profit by the contractors. There have been many cases where a contractor has hired a man much superior to himself (in every quality except the single one of being able to drive a sharp bargain), for a nominal sum, to superintend all the work on his contract, while he (the contractor) spends three-quarters of his time away on other business or pleasure.

In the progress of the art of manufacturing, it is fast coming to be recognized that the contract system, while it was probably the best twenty years ago, is, from a purely business standpoint, so no longer. This is an example of evolution of the ethical into the practical, which seems to mark all reforms. One of the most successful departments of a certain shop is now conducted on the basis of a salary, *and a percentage of the profits of that department.* Every dollar made by a contractor is a dollar *not* made by the proprietor, but every dollar made on the plan just mentioned represents a dollar, or perhaps fifty dollars, made by the proprietor. Cardinal Richelieu says (in the play), "Men gain doubly when they make foes friends." This is the whole principle of the matter; in other words, it is better to have men interested with and for us, than against us. Or, reduced to a still broader platform, "combination is better than competition," as everyone who has half an eye for the signs of the times will probably admit.

Competition has certainly outlived its usefulness in the great world, and seems destined to be altogether superseded by combination at no very distant day. Why should not the same thing be good for the little world of the shop?

Extreme thinkers will complain that this article does not go to the bottom of the matter. It is not intended that it should. It would be impossible to do so in one short article. Even if the writer is altogether wrong, some good will have been accomplished if some one more competent is moved to prove him so.

JAR-YES.

Cast or Cut Gears.

Editor American Machinist:

It appears to be somewhat of a novelty that a professedly first-class mechanic should advocate, in these days of improved tools and machinery, that cast gears can be made superior to those whose teeth are cut in an indexed machine. There are so many incidents liable to occur to the cast wheels, which do not occur to cut wheels, that it would seem that an amateur would hardly advocate such a theory.

First. Exceedingly few gear patterns have even been made as accurate as gears cut by those who construct first-class machinery.

Second. A good pattern, in the hands of a moulder or moulders, will not produce a uniformity of gears equal to cut wheels were there no other incidents of liability to inequality than that of a difference in rapping the pattern in order to draw it from the sand.

Suppose a case, that a moulder be given a 6-inch wheel (pitch line), 4 pitch teeth pattern, with an order to make a pair of wheels. This pattern is made by the shrink rule, it being intended that, when the wheels are cast, they shall be as near 6-inch wheels as the process entire will admit. Now, in moulding, the workman raps the pattern in the sand, so that one wheel is at least $\frac{1}{32}$ of an inch in diameter larger than the other. What then? Why, two different sized wheels from the same pattern. Again, the moulder is very liable to rap the pattern in such a manner that, when the wheels are cast, chucked and mounted, they are in reality miniature eccentric wheels. What then? Why, they are not equal to first-class cut gears, which are exactly round.

Third. The variety of the shrink of (iron) wheels produces an inequality from the same pattern ; a variety of iron causes variation.

Fourth. Cast wheels are not "chucked" with the precision that first-class cut gears are turned and cut.

The argument that the teeth of cast wheels will wear longer than those of cut wheels may appear quite plausible at first, but let us examine the subject considerately. First of all, the teeth of cast wheels are made at least one-twentieth thinner on the pitch line than those of cut wheels, and surely a thicker tooth will wear longer than the thin tooth.

But we are told that the skin of cast teeth, being harder than the cut-out surface of teeth, will wear longer. Did it ever occur to the advocates of this that the skin surface of a cast tooth is more or less necessarily rough and pitted, though but slightly so ? Did it ever occur to them that the skin of a cast tooth has imbedded (though miniature in particles) some of the moulding sand? If they don't always have sand in the skin they are extremely liable to, and do in the majority of cases.

In finely cut wheels the surface of tooth contact is of a uniform shape, of proper system. That surface is far smoother than the skin of any cast teeth. The surface contact of cut wheels is of clean iron, minus any presence of moulding sand. American machinists at least became aware of the superiority of cut gear wheels long ago.

Springfield, Mass. F. W. CLAUGH.

The Removal of Fumes, Smoke and Gas in Smith Shops.

At this season of the year, when closed doors and windows are a necessity, the smoke nuisance in smith shops, especially when starting up the fires in the morning, becomes of a very pronounced character, the fumes usually permeating every part of the factory. Hitherto relief has been chiefly sought by the employment of natural draft ventilators, placed in the apex or middle of the roof, with, however, but very indifferent results.

We illustrate herewith diagrams showing the application of a system which is claimed to afford positive relief at all times, regardless of atmospheric influences. These diagrams are taken from an equipment now in successful daily operation. Fig. 1 shows the ground plan of a smith shop running nineteen fires, with the system of piping by which they are supplied with blast from power blower, and the smoke and fumes drawn off by means of an exhaust or fan suction pipe.

Fig. 2 is a cross-section through the same shop, and Fig. 3 an elevation of one fire in detail.

Fig. 3 shows a canopy hood suspended over the fire, provided with a counterbalance weight, and connected with a branch pipe leading to the main flue by a telescopic joint, whereby the height of the hood from the fire may be varied at will. This feature is found to be of special convenience, particularly when starting up fires, as the hood can be lowered so as to completely enclose the fire, entirely preventing the escape of smoke; then, when fire is under way, the hood may be elevated to any height suited to the work.

The manufacturers believe that the proper construction of hoods and pipe connections for forge fires is not generally understood, and that superintendents and managers of shops, who are thoroughly well informed on all ordinary details of shop equipment and management, are frequently at fault here. The current impression is that, the larger the hood, or the more "flare" it has the better the results obtained. The fact they say, is that in no case should the extreme diameter of the hood exceed twice the diameter of the branch pipe to which it is connected. And very good results are secured by dispensing with the bell-shaped hood altogether, simply carrying the branch pipe, provided it is of sufficient size, down to within say 14 or 16 inches of the fire.

In Fig. 3 is shown the blower connected to the blast pipe, carried underneath the floor. This arrangement is in many cases advisable, as it usually requires less piping, is out of the way, and free from danger of breakage. When the blast pipe is laid in the ground, ordinary sewer tile makes an excellent conduit for the air.

The equipment illustrated herewith was furnished by the Buffalo Forge Company, Buffalo, N. Y.

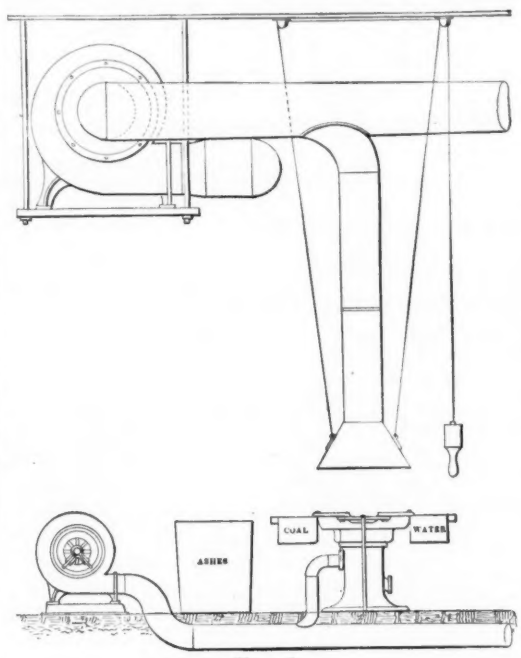
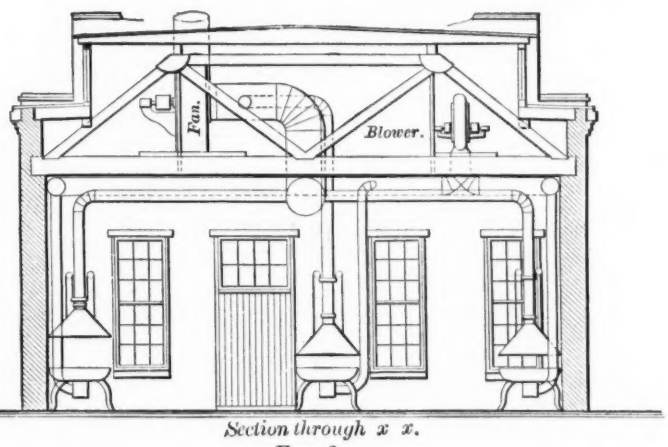


FIG. 3.



Section through x x.

FIG. 2.

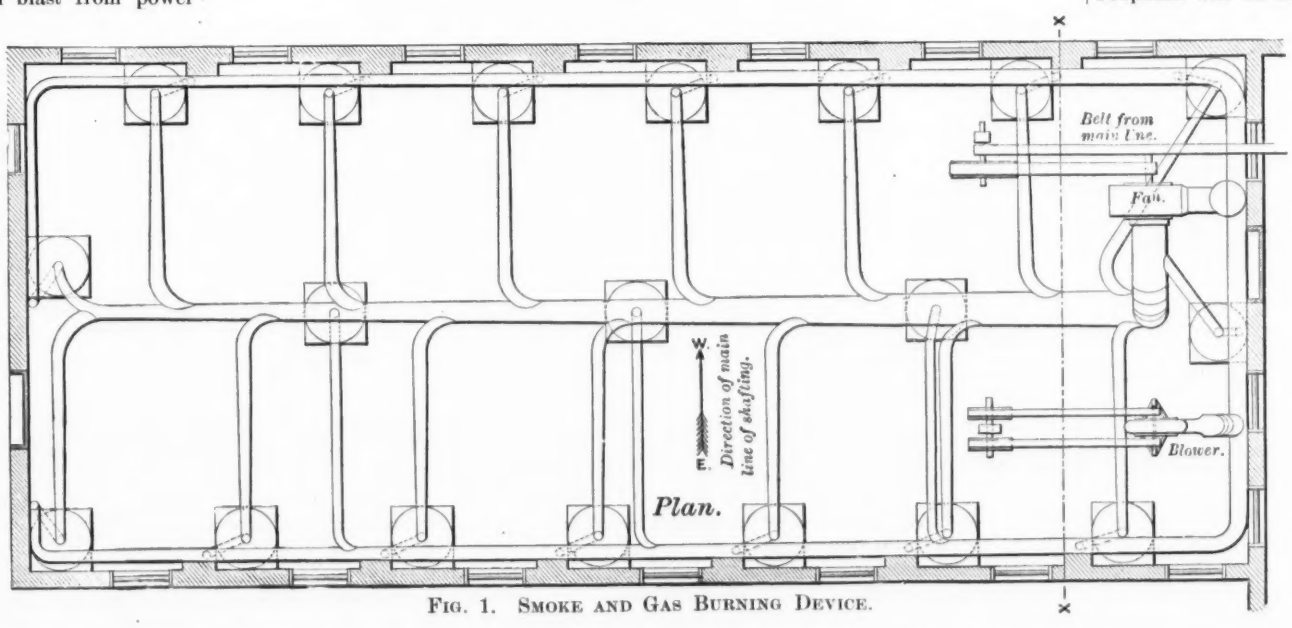


FIG. 1. SMOKE AND GAS BURNING DEVICE.

There are three steam street car railways in operation in Berlin. In the United States there is prejudice in favor of horse flesh, and this prejudice is so great, that steam cannot get a fair trial.

Sometime since, a zealous writer made the erroneous statement that it was impossible to utilize more than about ten per cent. of the heat liberated in the combustion of coal. The statement was so manifestly wrong that it would hardly seem necessary for anyone to correct it. But, as if to show that error is speedier than truth, this statement, modified a little to suit conditions, has traveled the rounds of the press, and in one instance, at least, has done service in demonstrating the possible saving by the use of a boiler that was to utilize a large part of the ninety per cent. that was not lost in the boiler.

An "engineer" in charge of a boiler in New York, which he was operating without the required license, recently undertook to test his boiler with cold water pressure from the hydrant. He had been running with 80 lbs. pressure, at least that was the story the gauge told, but when he got the 60 lbs. hyrant pressure on, he blew the tube sheet out. It was rather suggestive of what might have happened before with steam on ; but then he worked cheap.

The machinists of the country are gradually coming to the front and proving themselves to be men of uncommon capacity ; the latest instance being the case of a Baltimore machinist, who, upon a wager, ate five dozen raw eggs, including the shells, washing them down with a pint of alcohol. If this fellow remains in the active practice of the profession, he will, no doubt, become a bright and shining light ; but if he follows the usual course of such geniuses, he will now be likely to forsake the machine shop and start a saloon or become a freak in a dime museum. Alas !

The surface roads of New York find it necessary to combat a good deal of prejudice whenever they attempt to substitute some other motive power for horses. It seems to be a difficult matter for the roads to secure the privilege of making a trial of anything but horseflesh. But this prejudice will in the end be overcome, then the wonder will be that cars have for so long been propelled by means so unmechanical as that of horses.

A Big Wheel.

A Scranton, Pa., dispatch says :

The largest wheel of the kind ever made in this country, and probably the largest of any kind, is now in course of construction at the machine shop of the Dickson Manufacturing Company, on Penn avenue. It is what is called a sand wheel, and it is being made for the Calumet and Hecla Copper Company of the Lake Superior region. The great wheel will be 53 feet in diameter and several feet wide, and the Dickson Manufacturing Company will get $70,000 for it. It is being built around a 20-inch hollow shaft of gun metal, and it will weigh between 150 and 160 tons when completed. When the great wheel is put in place at the copper mines, it will be made to revolve slowly by means of enormous cogs on the surface of its circumference. These cogs are being cast in segments, and will weigh many tons in the aggregate. On each side of the mammoth wheel there will be 50 buckets, each of which will hold about 100 gallons, and these buckets will elevate the washings and dump them into a sluiceway. After the great wheel has been built up and all the finishing touches have been put on, it will be taken apart and shipped. Every piece will be numbered, so that there will be no trouble in putting the wheel together, and it will take eight or ten cars to transport it.

The Ré Umberto, recently launched for the Italian Government, is the largest war vessel in the world, her displacement being 13,298 tons. She is 400 feet long, by 76 feet 9 inches broad, and draws 29 feet of water. The armor on her barbettes is 19 inches thick, and she is fitted with a 3-inch steel protective deck. Her main armament will be four 104-ton guns and twelve of 4½ tons, whilst her engines are expected to give a speed of 18 knots.

The Government invites proposals for the construction of an armored vessel of 4,000 tons displacement, for coast defense. All the material entering into the construction of this vessel must be of American manufacture. Proposals will be received from any person able to show that he has or is in the way of having facilities for properly performing the work. The vessel must be completed within three years. Proposals are divided into three classes, viz.: For the construction of the vessel and machinery in accordance with plans, etc., provided by the secretary ; for the construction of the vessel and machinery according to these plans, with such modifications or changes as may be proposed by the bidder ; or for the construction of the vessel according to plans, etc., provided by the secretary, the contractor to put in engines, boilers and appurtenances of any design he may consider more suitable, not to exceed in weight, or space occupied, that allotted by the department's plans. This freedom, as regards design, gives the builder ample room for the display of any inventive or constructive genius he may possess, and undoubtedly will bring forth good results. In any event, it is not wise to assume that a naval board is wiser than all the rest of the people, in their wisdom. The wisdom of the whole is greater than that of a part.

AMERICAN MACHINIST

To prevent delays all Communications should be addressed to the Company.

PUBLISHED WEEKLY
BY
American Machinist Publishing Co.
96 Fulton Street, New York.

HORACE B. MILLER, Pres't and Bus. Manager.
LYCURGUS B. MOORE, Treas. and Sec'y.

F. F. HEMENWAY, Editor and Mech. Engineer.
J. G. A. MEYER, } Associates.
FRED J. MILLER, }

Special Announcements.

☞ *Positively we will neither publish anything in our reading columns for pay or in consideration of advertising patronage. Those who wish to recommend their wares to our readers can do so as fully as they choose in our advertising columns, but our editorial opinions are not for sale. We give no premiums to secure either subscribers or advertisers.*

☞ *Every correspondent, in order to insure attention, should give his full name and address, not for publication, but as a guarantee of good faith.*

☞ *We are not engaged in procuring patent rights, or in selling machinery, nor have we any pet scheme to advance, or hobby to ride.*

☞ *We invite correspondence from practical machinists, engineers, inventors, draftsmen, and all those specially interested in the occupations we represent, on subjects pertaining to machinery.*

☞ *Subscribers can have the mailing address of their paper changed as often as they desire. Send both old and new addresses. Those who fail to receive their papers promptly will please notify us at once.*

Subscription.

$2.50 a year in advance, postage prepaid in the United States, Canada and Mexico.
$3.50 a year to Other Countries, postage prepaid

Advertising.

Transient, 35c. per line, each insertion.
"Business Specials," 50c. a line.

The American News Company,
Publishers' Agents, New York.
The International News Company,
11 BOUVERIE STREET, Fleet Street, LONDON, ENG., will receive subscriptions for the AMERICAN MACHINIST, at 14/7 per annum, postage paid.

DEALERS SUPPLIED BY
The Albany News Company, Albany, N. Y.
The American News Company, New York, N. Y.
The Baltimore News Company, Baltimore, Md.
The Brooklyn News Company, Brooklyn, N. Y.
The Central News Company, Philadelphia, Pa.
The Cincinnati News Company, Cincinnati, Ohio.
The Cleveland News Company, Cleveland, Ohio.
The Colorado News Company, Denver, Colorado.
The Detroit News Company, Detroit, Mich.
The International News Company, New York, N. Y.
The Minnesota News Company, St. Paul, Minn.
The Montreal News Company, Montreal, Canada.
The National News Company, New York, N. Y.
The Newark News Company, Newark, N. J.
The New England News Company, Boston, Mass.
The New Orleans News Company, New Orleans, La.
The New York News Company, New York, N. Y.
The Northern News Company, Troy, N. Y.
The Omaha News Company, Omaha, Neb.
The Pittsburgh News Company, Pittsburgh, Pa.
The Rhode Island News Company, Providence, R.I.
The San Francisco News Co., San Francisco, Cal.
The South West News Company, Kansas City, Mo.
The St. Louis News Company, St. Louis, Mo.
The Toronto News Co., Toronto, Ontario, Canada.
The Toronto News Co., Clifton, Ontario, Canada.
The Union News Company, New York, N. Y.
The Washington News Company, Washington, D. C.
The Western News Company, Chicago, Ill.
The Williamsburgh News Co., Brooklyn, E. D., N. Y.

NEW YORK, DECEMBER 31, 1888.

CONTENTS.

	PAGE
Eberhardt's Automatic Rack Cutter	1
The "Ideal" Engine	1, 2
A New Year's Gift for the Foreman. By Frank Richards	2, 3
Practical Engine Testing. By W. H. Booth	3
Engineer's Wrench	3
Acton's Pressure Regulator	3
Crystallization and Shrinkage of Cast-Iron. By S. Boliand	4
Modern Locomotive Construction. By J. G. A. Meyer	5
Power from the Waves	5
The Modern Steam Plant and its Management. By Peter H. Bullock	5, 6
Letters from Practical Men: "Thinking and Wages." By J. G. Tramis—Covering for Pipes—Mental Processes. By W. E. Crane—Is the Contract System a Failure? By "Jar-Yes"—Cast or Cut Gears. By F. W. Claugh	6, 7
The Removal of Fumes, Smoke and Gas in Smith Shops	7
A Big Wheel	7
Natural Gas vs. Coal	8
Honor in the Machine Trade	8
Small Investors in Big Enterprises	8
A Practice that Should be Reformed	8
Dishonest Railroad Management	8
Literary Notes	8
Questions and Answers	8, 9
Manufactures	9
Machinists' Supplies and Iron	10

Natural Gas versus Coal.

When natural gas first came to be used to any considerable extent, it was predicted that it would revolutionize manufacture through furnishing fuel so cheap to those within the charmed circle reached by the gas, that those without would have no show for competition. This has not proved to be the case. In the first place, there have been some drawbacks in the use of natural gas for fuel, that were not counted upon in the beginning. These, however, are not serious enough to very materially affect the case. But the weak point in the assumption that gas would quite supplant coal in regions where it existed, was, that it was taken for granted that the gas would be furnished to consumers at a price merely nominal. This was a delusion, as many a manufacturer has found out, not entirely to his satisfaction. Starting in to use gas fuel at a price that saved a large percentage in the fuel bill, he has found that the law of supply and demand has operated to raise the price, until he is prone to debate the propriety of going back to the use of solid fuel.

The gas fuel scare—for it was at one time a scare—has been short-lived. To-day the question of reasonably cheap coal and crude oil is of infinitely greater importance than the question of natural gas. Those who get control of any natural product can be depended upon to put the price at as high a figure as it will bear, and nothing but competition with something of its kind will prevent this.

Honor in the Machine Trade.

The *Boston Courier* thinks that "The haste to be rich, and the decadence of mercantile and of artisan honor, have brought about a state of things where it has become necessary to assume that the intentions of every dealer and every workman are dishonest, and to be guarded against as such. Everybody recognizes this."

Well, it may be because we are uncommonly dull, but we fail to recognize any such condition of affairs in the machine business. If our Boston friend could go about amongst the machine shops with us for a while and see the constant efforts put forth by proprietors and workmen to improve the quality of their productions, we think he might conclude that there is at least one line of business, and one trade, in which there had been no very alarming "decadence of mercantile and of artisan honor." We think we could name several concerns in and about his own city, whose haste to be rich had not in the least impaired their integrity, and in dealing with whom, it would not be at all necessary to guard against dishonesty.

Of course, we cannot deny that there are machine builders whose efforts are mainly directed toward turning out something "cheap and nasty;" but this is by no means the rule. Anyone capable of judging the quality of machinery, can easily satisfy himself that there has been a very great improvement in the quality of work done upon most lines of machinery within the past few years; and improvement in quality of workmanship is not an indication of, or, in fact, compatible with, a very alarming decadence of mercantile and of artisan honor.

Small Investors in Big Enterprises.

Those who reason that the building of the Panama Canal will be permanently abandoned are fairly sure to be mistaken. Its completion may be delayed by the failure of De Lesseps to receive the means for carrying on the work, but it is, beyond much question, only a matter of time when it will be finished. And it seems to be about as certain that thousands of bondholders—most of them men who can ill afford the loss—will lose the most of or all the money they have put into the scheme.

This is not the first time that men who have worked hard for a little money have been inveigled into putting it into some enterprise, under the promise of large returns, to find in the end that, not only the dividends were not forthcoming, but that somehow the principal had been swallowed up. This used, a few years since, to be the case in railroad building in this country. Many mechanics and workingmen have put their hundred or two hundred dollars into a railroad, only to see it disappear—swallowed up by those who had more means and fewer scruples. The moral appears to be, that workingmen should not put their little savings into great schemes, in which the big fish are very sure to eat the small ones. When the promoters of some big enterprise resort to the effort of getting money in small sums from poor people, it is wise, on general principles, for those of small means to refuse to invest.

A Practice that should be Reformed.

There is in New York a practice that ought to be reformed, because it is contrary to every idea of justice, and an outrage upon decency. We refer to the practice of certain labor brokers, of delivering to contractors Italian laborers in droves, to all intents and purposes as if they were slaves. These deluded Italians work for wages entirely too small to furnish a decent living, are frequently huddled together in barracks that a New England farmer would not stable his cattle in, and robbed of a good percentage of the eighteen or twenty dollars a month which they may possibly earn, by a system of drawback charges, mostly for something they do not have, and by the contractors' storekeepers, from whom they buy, on credit, what little they have to eat.

This is a matter that can and should be controlled by legislation. It is not in the physical or moral interest of the country that men should be treated in this way because they are ignorant. It is demoralizing to the men themselves, to the observer, to those who can persuade themselves to treat men in this way, and to American labor, which must compete with a system materially worse, in many particulars, than anything known in the days of slavery. If the bringing to this country of ignorance is to be encouraged, the authorities are, in common decency, bound to protect it.

Dishonest Railroad Management.

There is trouble in railroad circles—especially in the West. The profits of stockholders have disappeared, and, as is to be expected, they are looking about for the reason. Railroad managers find a convenient scapegoat in the operation of the Interstate Commerce Law, but ordinary mortals do not believe this; and it is interesting to find so high an authority as Charles Francis Adams expressing himself as follows on the subject:

In my opinion, the difficulty is far more deep-seated and radical. In plain words, it does not lie in any act of legislation, State or national; and it does lie in the covetousness, want of good faith, and low moral tone of those in whose hands the management of the railroad system now is—in a word, in the absence among them of any high standard of commercial honor.

This is probably a true statement of the case, and no one would object very seriously to existing conditions, if the great railroad magnates were alone affected. But there are many who have about all they are possessed of invested in railroad securities, and they, naturally enough, look for deliverance from the recklessness and dishonesty that ruins them. Mr. Adams does not outline any very definite remedy for the present troubles, undoubtedly because he sees none. The prospect is not encouraging for those who have invested in railroad stocks, because such investments seemed to be safe and afforded a fair return.

The determination of the United States Government to create means of offensive and defensive warfare, is bringing inventors to the front. Dynamite shells being recognized as legitimate means to be employed against an enemy, we have first the dynamite gun to be used on shipboard, and now a Brooklyn inventor comes out with an invention covering a device for using dynamite for coast defense. He proposes to project the shells, charged with the destructive agent, from the periphery of a rapidly revolving wheel, and believes he can attain a range of five miles, and that he can discharge one hundred pound charges of dynamite every minute.

Literary Notes.

CURIOSITIES OF THE U. S. PATENT OFFICE. By William Chandler Raymond, formerly of the U. S. Patent Office. Illustrated. Wm. C. Raymond, Publisher, Syracuse, N. Y. Price, $1.50.

If the reader starts reading this book under the impression that he is to find dry details of patent matters and patent law, he will be mistaken. It is amusing all the way through, and it is instructive as well. The author, in his preface, after referring to the place such a book should fill, says:

"In the appended pages the author has endeavored to fill that void, and treat the subject in such a manner as to necessarily interest, entertain, instruct, and, to a degree, amuse the general reading public—as well as our inventive class.

"With what success this has been accomplished, the reader thereof may judge.

"From the inception of this work (some time ago) to the date of its completion, the author has, in addition to his own personal knowledge and observations, garnered from time to time, in the midst of his professional duties, as opportunity afforded, all important facts and information leaning or bearing upon the subject, and utilized them in the preparation of this book, and, as he has aimed to be as accurate in his statements as is well possible, not only have the best authorities been consulted, and information obtained from sources presumably authentic, but he has also received, directly or indirectly, assistance from officials of the Patent Office."

THE STEAM BOILER CATECHISM. A practical book for steam engineers, firemen, owners and makers of boilers of any kind. Covering the properties of steam and of fuels, and the theory and practice of designing, constructing, setting, connecting, testing, firing and repairing. By Robert Grimshaw, M. E. Profusely illustrated. New York, Practical Publishing Company. Price, $2.00.

The author of this book modestly disclaims any intention to greatly instruct expert engineers, but believes that even to such the book may be of value as serving to refresh the memory. It is a work of more than 400 pages, and, as is indicated by the title, consists of questions and answers which are quite fully indexed for convenient reference.

The examination questions of the New York, Philadelphia and Canadian Licensing Boards are distributed throughout the work, under their proper headings.

We have no doubt that the book will be appreciated by operative steam engineers, especially by the younger members of the craft, who cannot fail to find in it information worth to them several times its cost.

QUESTIONS AND ANSWERS.

Under this head we propose to answer questions sent us, pertaining to our specialty, correctly, and according to common-sense methods.

Every question, to insure any attention, must invariably be accompanied by the writer's name and address. If so requested, neither name, correct initials nor location will be published.

(579) E. G., Philadelphia, Pa., asks: How is steel fastened to the jaws of cast-iron vises? *A.*—See AMERICAN MACHINIST of March 1, 1884.

(580) T. H., New York, asks: Does salt water affect a screw propeller made of cast-bronze for a steamer? And will it affect the joints of the same material connected with the propeller. *A.*—No.

(581) J. K., Troy, Ohio, writes: Please inform me how much expansion and contraction there is in a wire of any given length in the extreme of summer heat and the extreme of winter heat. *A.*—See table in this issue also see AMERICAN MACHINIST, April 30, 1887, page 3.

(582) M. G., Chicago, Ill., asks: What size of boiler and engine will I need for a small boat 2½ feet wide and 14 feet long, to run at a rate of 16 miles an hour or less? *A.*—It seems to us that you will have to reduce considerably the speed of 16 miles an hour, otherwise the machinery will

take up too much space. You will need about a two-horse-power boiler and engine. Give the boiler about 20 square feet of heating surface and about 1 square foot of grate surface; cylinder for engine 2x4 inches. With these you may be able to obtain a speed of 6 miles an hour.

(583) E. T., New Haven, Conn., writes: I would like to know what would be a fair production of cleaned castings per net tons of pig iron used in a foundry making a medium class of machinery castings, using no scrap except sprues, etc.; pig, first class. *A.*—In a well-equipped foundry, under good management, the loss may be reduced to 4 per cent.

(584) E. H. P., Meriden, Conn., writes: Can you tell where I can procure a list or copies of foreign periodicals relating to mechanics, printed in the English language, German and French preferred? *A.*—Write to the American News Company, New York City. 2. Can you tell me what flux to use to solder iron to zinc, or iron to iron? *A.*—To solder iron to iron, apply good tough brass with borax mixed with water to the consistence of cream. For iron to zinc, you can try a solder of two parts tin and one part lead, using muriate of zinc as a flux, and a common soldering iron. To unite metals, we believe the best process is that of electric welding, which seems to be destined in the immediate future to take the place of soldering, etc. 3. Are there any publications on metal pattern making? *A.*—We have not seen a work specially devoted to this subject.

(585) D. S., Paulsboro, N. J., writes: The firm that I am employed by have put in a new tubular boiler. The boiler is 5 feet diameter, 16 feet long, with 84 tubes 2¾ inches inside diameter. Steam dome on the center of boiler, 30 inches diameter and 30 inches high. What is the horse-power of the boiler? How many square feet of heating surface should be allowed per horse-power in tubular boilers? *A.*—We generally allow 15 square feet of heating surface per horse power. Assuming ⅔ of the shell to be heating surface, the boiler will be about 78 horse-power. 2. The top of tubes in this boiler is 19 inches from top of boiler. In running, we find that the engine, when working hard, will often lift water out of the boiler. What is the best way to remedy the defect? Is it not caused by the boiler having too little steam room? *A.*—Yes, the cause is too little steam room. It seems to us that the tubes are placed rather high; according to good practice, the top of the upper row of tubes should be approximately three-fifths of the diameter of the boiler, which would give a distance of about 24 inches from the top of tubes to top of boiler, instead of 19 inches. The only remedy for your trouble is to increase the height of the steam dome, and keep the water level at a minimum.

(586) Metal, Newark, Del., writes: I would like you to tell me of some cheap metal that would expand and contract considerably, and I would like to know how much it would expand, say a piece one foot long; and also what degree of heat it would take to melt the same. *A.*—If we knew the purpose for which the metal is to be used we would be able to answer you more definitely. As it is, we can only give you the following table, from which you can make your own selection.

MATERIAL.	*Variation in Length for each 10 Degrees Change in Temperature.*	*Melting Point in Degrees.*
Antimony	.0000603	880
Bismuth	.0000772	512
Brass—Cast	.0001041	1760
Brass—Rolled	.0001054	
Copper	.0001003	2000
Iron—Cast	.0000617	2100
Iron—Wrought	.0000667	3200
Lead	.0001587	620
Steel	.0000653	2430
Tin	.0001225	450
Zinc	.0001700	780

No table, however elaborate, of the expansion of solid bodies by heat is absolutely correct.

(587) Moulder, ———, writes: In our foundry we are making some ho'low-castings; they are about 7-16 inch thick, and weigh from 300 to 450 pounds, according to size. We make three or four a day; the iron we have to pour them with is hot—too hot to pour hollow ware without slacking down. In each ladle of iron of about 175 pounds, the foreman puts about 2 ounces of lead. As we have to let the iron cool before we can pour, nearly all the lead burns up, and makes an awful smoke; and using 6 or 8 ladles a day you can imagine what a smoke it makes. The foreman says it cleans the iron, the men say it is not good for any other purpose than to make infernal smoke. Now what I want to know is this: Does lead put into the iron as hot as we have it do any good? The iron is the best pig, with only the sprues, waste and bad castings mixed with the pig iron. Are the fumes of so much lead injurious to health? *A.*—No advantages can, we think, be gained from the use of the lead with the iron as you state. The fumes from the lead are certainly injurious to health; and besides this, the lead will also impair the strength of the iron. To prove the latter, Mr. L. C. Jewett made some experiments and writes as follows: I had two test bars cast; they were 1 inch square, and cast from the same pattern. One bar had 1 ounce of lead to 20 pounds of iron; that is, about 3-10 of 1 per cent.; the other bar was made from our regular mixture for good finished work. In testing these bars we found that the strength of the bar with lead was reduced nearly 12 per cent.

BUSINESS SPECIALS

Transient Advertisements 50 cents a line for each insertion under this head. About seven words make a line. Copy should be sent to reach us not later than Thursday for the ensuing week's issue.

Gear wheels and g-cutting. Grant, see adv., p. 16.

Link Belting.

Send for Catalogue of Link-Belting.

Over 50,000,000 feet of Link-Belt in use.

Link-Belt Machinery Co., Chicago and N. Y.

Shafting Straighteners. J. H. Wells, Tampa, Fla.

Steel Name Stamps, etc. J. B. Roney, Lynn, Mass.

The Improved Justice Hammer. Williams, White & Co., Moline, Ill., manufacturers.

The Best Upright Hammers run by belt are made by Jenkins & Lingle, Bellefonte, Pa.

Pattern and Brand Letters. Vanderburgh, Wells & Co., cor. Fulton and Dutch sts., New York.

"Swift" Sight Feed Lubricator; no glass tubes; simple, reliable. Swift Lub'r Co., Elmira, N. Y.

Mechanical drawing taught by correspondence. Thoroughly practical. I. Donald Boyer, Dayton, O.

"How to Keep Boilers Clean." A 96 page book mailed free by Jas. E. Hotchkiss, 120 Liberty St, N.Y.

Davis Key-Seating Machines kept in stock by Manning, Maxwell & Moore, 111 Liberty st., N. Y.

"Bradley's Power Hammers, the best in the world." 20 sizes. Bradley & Co., Syracuse, N. Y.

Selden Packing, for stuffing-box, with or without rubber core. Randolph Brandt, 38 Cortlandt st., N.Y.

R. Dudgeon, 24 Columbia st., New York. Improved Hydraulic Jacks and Roller Tube Expanders.

Brown & Sharpe Mfg. Co. have a line of machinery with S. A. Smith, 23 S. Canal st., Chicago, Ill.

Ice and Refrigerating Machines, 131 sold, and all successful. David Boyle, 521 Monroe st., Chicago, Ill.

Common sense oil filters are a wonder. They repay cost quickly. C. F. Baker, Minneapolis, Minn.

For the latest improved Diamond Prospecting Drill, address the M. C. Bullock Mfg. Co., 138 Jackson st., Chicago, Ill.

Engine lathes, hand lathes, fine tools, files and supplies for machinists and other metal workers. Frasse & Co., 92 Park Row, N. Y.

Upright drills, improved, sizes 21", 23", 25", 28" 32", 36" swing; finely made and great capacity. Currier & Snyder, Worcester, Mass.

The Waterhouse Arc Light for Factories in entirely satisfactory. The Waterhouse Electric and Manufacturing Co., Hartford, Conn.

Patents obtained. Patent litigation conducted R. G. DuBois, Patent Attorney, 928-930 "F" street, Washington, D. C. Correspondence invited.

Send for Descriptive Catalogue of "Roper's Hand Books" for engineers and firemen. Edward Meeks, Publisher, 1012 Walnut street, Philadelphia, Pa.

Split Pulleys at low prices and of same strength and appearance as Whole Pulleys. Yocum & Son's Shafting Works, Drinker st., Philadelphia, Pa.

See illustration of improvements in Hooks for Steam Engines, in Nov. 24 issue. For particulars address T. C. Dill Machine Co., 726 Girard av., Phila. Pa.

Fine tools and supplies for machinists and other metalworkers. Get our prices before purchasing elsewhere. Montgomery & Co., 105 Fulton st., N. Y. City.

Curtis Pressure Regulators. Curtis Return Trap. Curtis Damper Regulator. See Dec. 1, p 15. Send for circular No. 17. Curtis Reg. Co., Boston, Mass.

The Holly Manufacturing Company, of Lockport, N. Y., will send, on application, their pamphlet illustrating pumping machinery and reports of duty trials.

With my System, Exhaust Steam Heating costs nothing for fuel; Live Steam Apparatus altered to Exhaust. Satisfaction guaranteed. Geo. A. Barnard, 15 Cortlandt street, New York.

W. H. Hoffman, consulting engineer, 108 Liberty st., room 3, N. Y. Mechanical engineering in all its branches, working drawings for the transmission of power by steam, water, air and electricity.

Contract work of all kinds executed promptly and on reasonable terms. Parties wishing gray iron castings in large quantities can make money by corresponding with Rawson Mfg. Co., Hornellsville, N. Y.

The Vance Lightning Flue Cutter is *the* tool for removing old flues from boilers and locomotives (will cut fifty an hour); sent on approval to railroad companies. Vance Tube Cutter Co., Geneva, N. Y.

"Curiosities of the U. S. Patent Office." Just out. Unique, Entertaining, Instructive, Amusing. An Elegant, Illustrated, Cloth-bound book. Price, $1.50. Descriptive pamphlet *free*. Wm. C. Raymond, Publisher, Syracuse, N. Y.

A system of easy lettering, by J. H. Cromwell giving 26 forms of alphabets. The space to be lettered being divided into squares; simple and effective. Price 50 cents. Catalogue of books for engineers free. E. & F. N. Spon, 12 Cortlandt st., N. Y.

Special facilities for the manufacturing of all kinds of light machinery, hardware and novelties, by contract or otherwise. Presswork and stamping done on short notice. Estimates furnished. Punches, dies and special tools made when required. Rockaway Mfg. Co., 3 E. 14th street, New York.

"Indicator Practice and Steam Engine Economy." By F. F. Hemenway. Contains plain directions for using the indicator, and making all required calculations from the diagram; also the principles of economy in operating steam engines and current practice in testing engines and boilers. Price $2, postpaid. Published by John Wiley & Sons, 15 Astor Place, New York.

"Binders" for the AMERICAN MACHINIST. Two styles, the "Common Sense," as heretofore sold by us, and mailed to any address at $1.00 each, and the "New Handy," mailed at 50c. each. The former has stiff board covers, while the latter has flexible covers, with full page opening flat. Either will hold the entire 52 issues of any volume. AMERICAN MACHINIST PUB'G CO., 96 Fulton st., New York.

"Practical Drawing" By J. G. A. Meyer. The above series of articles, now running in the AMERICAN MACHINIST, should be closely followed by every student. They commenced with October 23, 1886 issue, and up to and including Dec. 15, 1888 issue 65 articles have been so far published. Copies containing these articles sent by mail to any part of this country or Canada at 5 cents each. AMERICAN MACHINIST PUBLISHING CO., 96 Fulton st., New York.

"Modern Locomotive Construction." By J. G. A. Meyer. The above series of articles, now running in the AMERICAN MACHINIST, are attracting the attention of railway mechanics all over the world. Commencing with the June 27, 1885 issue, 80 articles have thus far appeared up to and including the Dec. 20, 1888 issue. Copies containing these articles sent by mail to any part of the U. S. or Canada at 5 cents each. AMERICAN MACHINIST PUBLISHING CO., 96 Fulton st., New York.

MANUFACTURES

A. E. Runken will build a bucket factory at Fayetteville, N. C.

Captain Henry will build an electric light plant at Versailles, Ky.

W. Richardson is interested in building a woolen mill at Louisville, Ky.

The Globe Iron Works, lately burned at Cleveland Ohio, will be rebuilt.

J. R. Wimberly is interested in building a cotton compress at Hope, Ark.

J. A. Sugg is interested in building a wagon factory at Pittsboro, Miss.

J. A. Reynolds is interested in building a chair factory at Tallapoosa, Ga.

E. Howard is organizing a company to build a large saw mill at Louisville, Ky.

The Lima Lock Co. has been incorporated, to manufacture locks at Lima, Ohio.

W. R. Polk has started a machine shop for repairing electrical machinery at Atlanta, Ga.

The Equitable Gas Light and Fuel Company have applied for a charter at Washington, D. C.

Lester Brothers are building a shoe factory at Binghamton, N. Y. It will be three stories, 50x500 feet.

The West Virginia Central & Pittsburgh Railway Co. propose to build machine shops at Leadville, W. Va.

The Commonwealth Company will build a shoe factory at Marlborough, Mass. It will be four stories, 44x250 feet.

The Cherokee Land and Iron Company have let the contract for building a large rolling mill at New Birmingham, Tex.

Oscar Lynch contemplates adding to his iron works at Fort Worth, Texas, a factory for manufacturing plows, sulkies, harrows, etc.

The Salisbury (N. C.) Knitting Co. will build a factory at Salisbury, N. C. It will be two stories 40x100 feet, with boiler and engine rooms in addition.

The American Cotton Oil Co. contemplate the erection of a mill to make paper stock from the refuse of their cotton-seed oil mill at Little Rock, Ark.

The new bicycle factory of the White Cycle Co., at Westboro, Mass., is now nearly completed. There are two buildings, one 50x152 feet, and the other 30x50 feet.

The Collins-Gibbons Manufacturing Company, St. Louis, Mo., will enlarge their plant, preparatory to building larger machines for straightening and cutting wire.

The Kentucky Union Land Co., of Louisville, who are building the Kentucky Union Railroad, and own about 500,000 acres of land, will build a manufacturing town at Clay City, Ky.

The extensive blast and puddling furnaces and wire mills of Mercer & Lynn, at Bellefonte, Pa., which have been idle for over four years, resumed operations on the 10th inst.

The works of the Rome Nail Manufacturing Company, Rome, Ga., which were destroyed by fire two weeks ago, involving a loss of $15,000, will be rebuilt at once on a much larger scale.

The Kensington Engine Works, Philadelphia, Pa. have issued a very neat catalogue of the Kensington Feed-Water Heater and Purifier. The cuts are excellent, and the descriptive matter unique.

The Ohio Falls Oak Leather Co., of Louisville, Ky., are rebuilding their burned tannery. The building will be of brick, five stories, 35x190 feet, vat-house 96x180 feet, and boiler-house 50x50 feet.

The Betts Machine Co., Wilmington, Del., have had a good trade in heavy machine tools, particularly in their horizontal boring and drilling machines, heavy planers, large boring and turning mills, frog planers, and radial drilling machines.

Felthousen & Sherwood, Buffalo, N. Y., inform the trade by circular that they are owners of the patents on the Engineer's Favorite Tube Cleaner, and that they will hereafter be sole manufacturers.

E. P. Bullard, 62 College place and 72 Warren street, New York, has issued a card catalogue of machinery on hand and for sale. One side of the card is devoted to a list of the machines, and the other to engravings.

The Beckett Foundry & Machine Company, Arlington, N. J., have bought the entire patterns and drawings of the Munzer-Corliss engine, and have begun their manufacture. They have patterns for sizes from 10" × 22" to 16" × 36", and will add larger sizes as required.

The new works of the Keystone Iron Works Company, of Kansas City, Mo., builders of boilers, engines, and general machinery, are ready for occupancy, the completion of railroad facilities being the only thing which is now awaited before removing to the new establishment.

The Central Iron and Steel Company, of Brazil, Ind., has added a department to its works for the manufacture of turn-buckles used by bridge builders and others. A feature in the work is the manufacture of the buckles in two pieces instead of four, which has hitherto been customary.

The Birmingham Mining and Manufacturing Company has completed and blown in its 100 ton iron furnace. The company will hold a meeting on the 27th inst., at its office at Birmingham, Ala., to consider issuing $300,000 of bonds. The building of an additional furnace is contemplated.

The Pole-Road Locomotive Co. has been chartered to manufacture pole-road locomotives at Richmond, Va., with R. A. Lancaster, of New York, as president; William H. Lucke, secretary and treasurer, and J. A. Yancey, general manager. The capital stock is not to be less than $150,000 nor more than $500,000.

John A. Greenleaf, of Lewiston, Me., has closed a contract with the Shawmut Fiber Company for the erection of the largest pulp mill in the United States, if not in the world. It is to be built at Somerset Mills, Me., and ex Gov. A. H. Rice, is one of the projectors of the enterprise. The buildings will be nine in number.

A new company is to be organized at Louisville, Ky., which will build a new woolen mill, with larger capacity than any other in the city. A site has, it is said, been purchased on Beargrass Creek, where the new mill will be located, and that Mr. Walter Richardson, who has been connected with the Old Kentucky mills, will have the management of the enterprise.

There is water-works agitation at Uniontown Ala.; Washington, Ga.; Washburn, Wis.; Burlington, Wis.; Georgetown, Ky.; Central City, Ky.; Huntingburg, Ind; LaGrange, Ga.; Nicholas, Ky.; Rockmart, Ga.; Stayner, Ont.; Beaumont, Cal.; Helena, Ark.; Cedartown, Ga.; Monroe, Mich.; Goldsboro, N. C.; Cleveland, Tenn.; Abingdon, Pa.; Grinnell, Iowa; Milwaukee, Wis.; Hull, Mo.; East Randolph, N. Y.

The National Pipe Bending Co., of New Haven, Conn., manufacturers of the National Feed-Water Heater, and of all styles of coils and bends in iron, brass or copper tubing, report a very large and increasing business for the months of October and November, the heaters sold for the two months aggregating over 11 000 horse power, which have been sent to all parts of the United States, including one 1,000 horse-power, one 600 horse-power, four 500 horse-power, and twelve 100, 200 and 300 horse-power heaters.

The Acme Machinery Co., Cleveland, Ohio, are building a two-story brick machine shop, 50x120 feet; also a separate L 32x40 feet, to connect the new shop with the present one. The L is to be three stories high. The lower story will be used for offices and tool room, the second story for stock room, and the upper story for drafting room. This company started in business four years ago, to manufacture the Acme Bolt and Screw Cutter, employing six hands. At present they employ 54 outside the foundry.

The East Pittsburgh (Pa.) Improvement Company has been organized by George Westinghouse, jr., John Caldwell, John R. McGinley, H. H. Westinghouse, Charles Paine, Robert Pitcairn, Caleb H. Jackson, John Dalzell, William Scott, T. A. Gillespie and Walter D. Uptegraff. Capital stock, $500,000. The object of this corporation is to effect a saving of natural gas by selling property in the heart of the gas territory to manufacturers. It holds for this purpose about 600 acres lying between Turtle Creek and Wilmerding. This property is all to be sold out as a new town.

The following will explain itself: Cleveland, O., Dec. 9, 1888.—Owing to the very large extension of our line of manufacture, we have considered it advisable to change our corporate name. We shall still continue to make our patent seamless steel elevator buckets a prominent feature of our business, and when we are settled in our extensive new works, about the twentieth of December, will be prepared to do the most intricate stamping and shaping of metals ever attempted in any country. Thanking you for all past business, and asking a continuance of your esteemed favors, we are, yours respectfully, The Avery Stamping Company, successors to The Avery Elevator Bucket Co.

A St. Louis dispatch says: A dispatch from the City of Mexico says that, before Congress adjourned Saturday night, the Union Light, Fuel and Gas Company of America, organized under the laws of Illinois, in which St. Louis, Chicago, New York and Detroit capitalists are largely interested, through the efforts of Charles Wimple, general manager, and George Hill Howard, attorney of the company, obtained an important concession from the Mexican Government for the introduction of water, fuel and gas into all the cities and government buildings throughout the republic. Among the important things mentioned in the concession, is the free importation for fifteen years of all materials necessary for the plant.

A Charleston (S. C.) dispatch says: At the annual meeting of the Cotton Exchange yesterday, a report was made on experiments conducted through the summer with pine fiber cotton bagging as a substitute for jute bagging. The report brings out some points which are considered important. It has been demonstrated that the pine fiber cotton bagging can be manufactured at almost any weight per yard. It will not rot nor stain cotton. It can be manufactured and sold at less price than jute bagging, even if jute should be placed on the free list. The committee under whose direction the experiments were made, think that, with improved machinery, the manufacture of pine straw bagging will become one of the most profitable industries in the South. The raw material costs absolutely nothing beyond the expense of gathering it from the ground and transporting it to the mills.

Machinists' Supplies and Iron.

New York, Dec. 20, 1888.

Iron—American Pig—There has been little disposition recently to engage in new operations before the first of the year, and trade is consequently confined to what is necessary to supply immediate wants. We quote Standard Lehigh and North River brands No. 1 X Foundry, $18 to $19; No. 2, $17 to $17.50; Grey Forge, $15.50 to $16.25.

Scotch Pig—We quote Coltness, $20.50 to $21; Gartsherrie, $20; Summerlee, $20.50; Eglinton, $19 to $19.25; Dalmellington, $19.50 to $20; Clyde $20.50, and Langloan, $20.50.

✲WANTED✲

"Situation and Help" Advertisements only inserted under this head. Rate 30 cents a line for each insertion. About seven words make a line. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue.

Wanted—See bottom of third column, page 11.

Wanted—A brass moulder who can make solid castings. Address B. C., care American Machinist.

Practical machinery moulder wants shop to run by the ton, or will take job on floor; sober and steady. Foundry, Box 115, Ballston Spa, N. Y.

Mech'l draftsman, familiar with machine and pattern maker's trades, wants employment at once; best ref. W. M. B., New National Hotel, Auburn, N. Y.

Young man, thoroughly acquainted with automatic engine work, desires position as foreman of shop building light automatics. Box 548, Alliance, O.

First-class draftsman wanted immediately on engine design. State experience, age, references and salary expected. Bucyrus Foundry & Manufacturing Company, Bucyrus, Ohio.

Wanted—An experienced salesman in the line of heavy machinery, to take charge of an established branch store. A permanent position for the right man. Address with references, R. S. Kendall, care of American Machinist.

Wanted—Foreman for Steam Pump Works. Must be competent to handle men, with a thorough system, and to get out work in Single and Duplex form rapidly and correctly. State age, wages and experience. Address Box 51, American Machinist.

✢ MISCELLANEOUS WANTS ✢

Advertisements will be inserted under this head at 35 cents per line, each insertion.

Crescent solid lubricant, clean, durable, cheap; prevents hot boxes. Crescent Mfg. Co., Cleveland.

The Crescent automatic grease cup is adapted to every service. Crescent Mfg. Co., Cleveland, Ohio.

Light and fine machinery to order; Foot Lathe. Catalogue for stamp. E. O. Chase, Newark, N. J.

August C. Christensen, 24 State st., N. Y., consulting engineer for hydr. and pumping machinery, etc.

Punches, dies and special machinery built to order C. F. Langston & Co., 70 N. 4th St., Phila., Pa.

Correspondence solicited with parties having machine or foundry specialties to build. Honesdale Iron Works, Honesdale, Pa.

Wanted.—To buy second-hand lathes, planers and shapers of all sizes; must be cheap and in good order. Fosdick & Plucker, 6th and Culvert Streets, Cincinnati O.

How to remove and prevent scale in steam boilers at a cost of ten cents a week. Send postal for circular to Pittsburgh Boiler Scale Resolvent Co., Pittsburgh, Pa.

Foreclosure Sale—The valuable Patents on Refrigerating and Ice Machines belonging to W. H. Wood; also drawings and patterns for machines in successful operation, with formula for ammonia gases, etc. Apply Box 54, American Machinist.

Edwards' Works on the Steam Engine

The American Steam Engineer. Theoretical and Practical: with examples of the Latest and Most Approved American Practice in the Design and Construction of Steam Engines and Boilers of every Description. For the use of Engineers, Machinists, Boiler Makers and Students. By Emory Edwards, M. E. Illustrated by 77 engravings. 12mo, 419 pages, . . . $2.50

Modern American Marine Engines, Boilers and Screw Propellers. Their Design and Construction, showing the Present Practice of the most eminent Engineers and Marine Engine Builders in the United States. By Emory Edwards. Illustrated by 30 large and elaborate plates. 4to, ... $5.00

The Practical Steam Engineers' Guide in the Design, Construction and Management of American Stationary, Portable, and Steam Fire Engines, Steam Pumps, Boilers, Injectors, Governors, Indicators, Pistons, and Rings, Safety Valves and Steam Gauges. For the use of Engineers, Firemen and Steam Users. Illustrated by 119 engravings 420 pages, 12mo, $2.50

A Catechism of the Marine Steam Engine. For the use of Engineers, Firemen, and Mechanics. A Practical Work for Practical Men. Illustrated by 63 engravings, including examples of the most modern engines. Third edition, thoroughly revised, with much new matter. 12mo, 414 pages, . . $2.00

Modern American Locomotive Engines. Their Design, Construction, and Management. Illustrated by 78 engravings. 12mo, 383 pages, . . $2.00

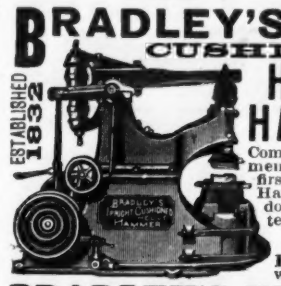
☞ *The above or any of our Books sent by mail, free of postage, at the publication prices, to any address in the world.*

☞ *Illustrated Circulars, showing full tables of contents of all of the above valuable books, will be sent free to anyone in any part of the world, who will send his address.*

☞ *Our New and Revised Catalogue of Practical and Scientific Books, 84 pages, 8vo, as well as our other Catalogues and Circulars, the whole covering every branch of Science applied to the Arts, sent free and free of postage to anyone in any part of the world who will furnish his address.*

HENRY CAREY BAIRD & CO.,
Industrial Publishers, Booksellers & Importers,
810 Walnut St., Philadelphia, Pa., U. S. A.

BRADLEY'S UPRIGHT CUSHIONED HELVE HAMMER



Established 1832

Combines the best elements essential in a first-class **Hammer.** Has more good points, does more and better work and costs less for repairs than any other **Hammer** in the world.

BRADLEY'S HEATING FORGES.

Established 1832

With a manufacturing experience of over half a century, we recommend these machines to be the best, simplest, most durable and combining all the essential elements. **For hard coal or coke.** Indispensable in all shops. Pat. Aug. 30, 1887.

keep Bradley's Cushioned Hammers and men fully employed and reduces cost of production.

BRADLEY & CO.
SYRACUSE, N. Y.
98 Sudbury St., Boston, Mass.
63 Murray St., New York.

—COMPOUND—
Automatic Water Heater,

Heats water to 212°, without pressure. With pressure will heat water to 320°.

NO COST FOR FUEL. UTILIZES WASTE HEAT. NO SWEATING. NO CORROSION. SAVES FROM 15 TO 25 PER CT. OF FUEL.

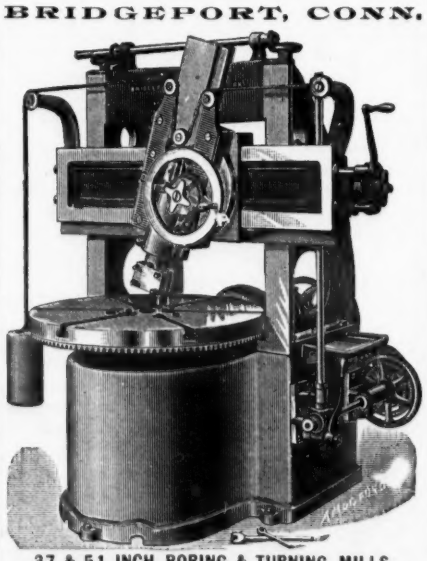
The most perfect and effective Feed Water Heater ever devised.

SEND FOR CIRCULAR.

THE HUSSEY RE-HEATER
—AND—
STEAM PLANT IMPROVEMENT CO.
15 Cortlandt Street, New York.
A. S. Hatch, Pres. S. D. Brewer, Gen. Man.

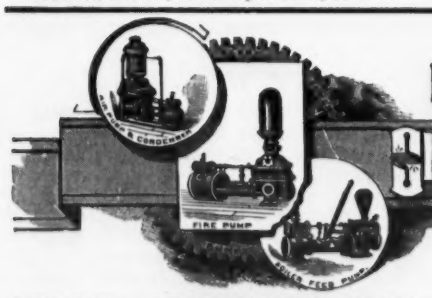
TANITE EMERY WHEELS and GRINDING MACHINES
FOR SAW MILLS, FOUNDRIES AND MACHINE SHOPS
For Circulars address
THE TANITE COMPANY, STROUDSBURG, MONROE CO., PA.
Or H. A. ROGERS, 19 John St., N. Y.

Bridgeport Machine Tool Works,
E. P. BULLARD, Prop.
BRIDGEPORT, CONN.



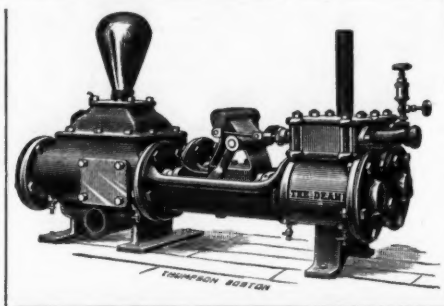
37 & 51 INCH BORING & TURNING MILLS, LATHES, SCREW MACHINES, TURRET MACHINES, &c.

IRWIN VEEDER,
Expert and Solicitor of Patents.
Six years' practical experience in shops after receiving a technical education and before entering the practice.
Rooms 309-11, 225 Dearborn Street, Chicago.
J. H. Raymond, of Counsel.



93 Liberty St., New York. | 113 Federal St., Boston.

IMPROVED PUMPING MACHINERY | For Every Class of Work | Send for New Illustrated CATALOGUE.



THE DEANE STEAM PUMP CO.,
HOLYOKE, MASS.,
New York, Boston, Chicago, Philadelphia
St. Louis,
Manufacturers of
STEAM and POWER
PUMPS
FOR ALL PURPOSES.
SEND FOR CATALOGUE.

The Hendey Geared Friction Planer,
16 inch x 16 inch x 4 feet.

For Die Work and use in Tool Rooms this planer is particularly adapted. It will plane accurately to a line, and stroke can be quickly changed from one inch to full capacity of table (4 feet), maintaining at the same time a uniform cutting speed. It has a cone pulley for change of speed, and automatic horizontal, vertical and angular feed. For above work it has proved a superior tool.

For Planers, Shapers or Engine Lathes, address
THE HENDEY MACHINE CO., TORRINGTON, CONN.

IT PAYS TO USE THE BEST.

That is why **CRESCENT EXTRA STEEL** is found in so many well managed shops where results are closely watched.

For general machine shop tools and dies it is the most satisfactory steel you can get anywhere.

MILLER, METCALF & PARKIN,
CHICAGO, ILLS. PITTSBURGH, PA. NEW YORK, N. Y.

Sebastian, May & Co.'s Improved Screw Cutting
FOOT AND POWER **LATHES**

Drill Presses, Shapers, Band, Circular and Scroll Saws. Machinists' Tools and Supplies. Lathes on trial. Catalogue mailed on application.
167 West Second Street, CINCINNATI, O.
OUR SPECIALTIES, 8, 12, 14 and 18 inch Lathes.

STEPHENS' PATENT VISES.

QUICK-ADJUSTING CAM AND TOGGLE JOINT.
Stationary or Patent Swivel Bases.
INCOMPARABLE FOR STRENGTH, DURABILITY FIRM HOLD AND QUICK WORK.
Has improved Taper, Pipe and other attachments. Made in 2, 2¾, 3½, 4½, 5½, and 6½ inch width of jaw.
Sold by the Trade. Send for Circular.
TOWER & LYON, MFR'S,
95 CHAMBERS ST., NEW YORK.

FINE TAPS, DIES, REAMERS, ETC.

LIGHTNING AND GREEN RIVER SCREW PLATES.
Bolt Cutters, Hand and Power Drilling Machines, Punching Presses, Tire Benders, Tire Upsetters and Other Labor-Saving Tools. Send for Price List.
WILEY & RUSSELL MFG. CO., GREENFIELD, MASS.

"Star" Foot Lathe Swings 9x25 in. | LATHE | Screw Cutting Automatic Cross Feed, etc.
Scroll Saws, Circular Saws, Lathes Mortisers. | Catalogue Free of all our Machinery.
Seneca Falls Mfg Co 687 Water St., Seneca Falls, N.Y

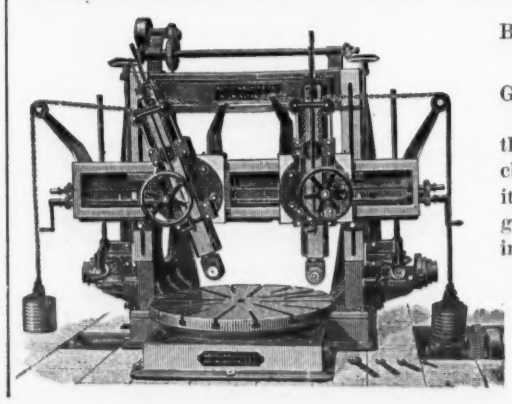
JONES & ROGERS,
5 West 4th St., Cincinnati, O.,
CONSULTING ENGINEERS.
Machinery Designers.
Standard Drawings Made.
Blue-Printing a Specialty.
WE CAN SAVE YOU MONEY.
We never sleep. WRITE TO US.

FOR SALE, CORLISS ENGINES.
The **Fishkill Landing Machine Co.,** located at **Fishkill, on the Hudson, N. Y.,** offer to manufacturers and others desiring a well built, economical and durable engine, their improved **CORLISS ENGINES.** They are endorsed by many reputable engineers and persons using them. Address as above.

ERNEST W. NAYLOR,
CONSULTING ENGINEER, 149 B'way, N. Y.
Designer of hand, steam, power, and hydraulic jib cranes, square shaft, rope, hand and hydraulic traveling cranes. 20 years best English experience.

THE CELEBRATED
HEALD & SISCO
CENTRIFUGAL PUMPS
Vertical and Horizontal.
COOKE & CO.,
22 Cortlandt St., New York.

In Writing Mention this Paper.



Pittsburgh, Pa., Apr. 20th, 1888.

Betts Machine Co.,
Wilmington, Del.

Gentlemen:—

In reply to your inquiry concerning the 7 foot Boring and Turning Mill purchased from you, would say that I find it as near perfect as you possibly could get it. Although being rigid and strong in its construction, it is easily adjusted.

I have bored and turned pulleys 12 ft. diameter, and 26 in. face, with case. In short, I consider it one of the best tools in the market.

Yours very truly,
Wharton McKnight

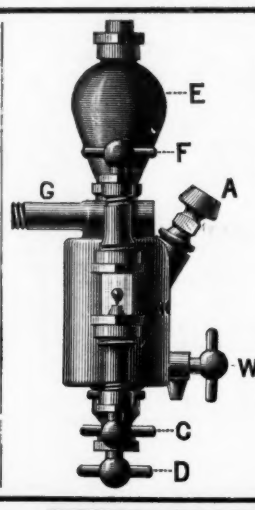
NICHOLSON FILE COMPANY,

PROVIDENCE, R. I.

Files and Rasps.

In magnitude, variety and excellence of product, this company has no equal in this, or any other country.

Steam Pipe.



THE "VOLUNTEER"
UP-DROP, SIGHT FEED, LUBRICATOR,

(GATES PATENT.)

FOR STATIONARY ENGINES AND PUMPS OF ALL KINDS. LUBRICATORS FOR SINGLE OR DOUBLE CONNECTION.

PRICE LIST.

Nos.	1	2	3
Price	$10.00	$12.00	$15.00
Capacity	⅓ pt.	½ pt.	¾ pt.

NATHAN MANUFACTURING CO.,
92 & 94 LIBERTY STREET, NEW YORK,

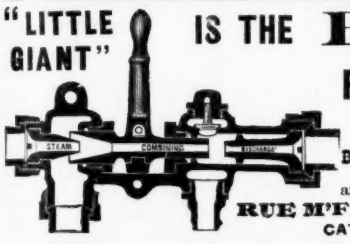
Send for Catalogue. SOLE MANUFACTURERS.

Established in 1874.

CLEVELAND TWIST DRILL CO.

Corner Lake & Kirtland Sts., Cleveland, O
101 Chambers Street, New York.
85 Queen Victoria St., London, Eng.

"LITTLE GIANT" IS THE **Best Injector**



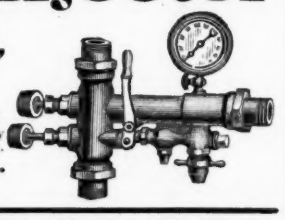
For Feeding all Steam Boilers.

RUE'S ◆ EJECTOR,

Superior to all others for Raising and Forcing Water and other Liquids.

Boiler Washer and Testing Device

Uses Warm Water, avoiding injury and facilitating the Raising of Steam.



RUE M'F'G CO., PHILA., PA.
CATALOGUES FREE.

FITCHBURG MACHINE WORKS.

Manufacturers of

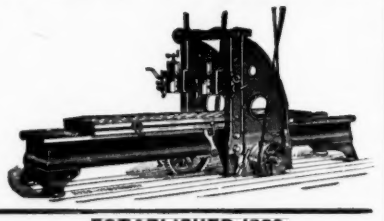
METAL-WORKING MACHINES.

Office and Works,

13 to 21 Main Street,

FITCHBURG, MASS.

Send for Catalogue (E.)



HOWE, BROWN & CO., Limited,

ESTABLISHED 1859.
Formerly HUSSEY, HOWE & CO., Limited.
PITTSBURGH, PA.

Manufacturers of all kinds

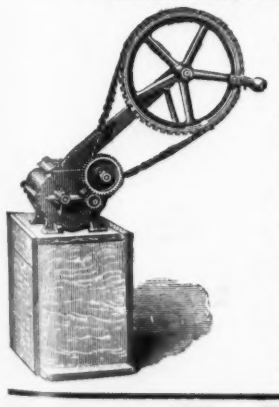
CRUCIBLE AND OPEN HEARTH STEEL, CAMERON SELF-HARDENING STEEL,

For Shearing Tools and Turning Steel Tires.

BRANCH OFFICES: Boston, 127 Oliver St. New York, 12 Cliff St. Chicago, 171 La Salle St.

ROOTS' NEW ACME HAND BLOWER.

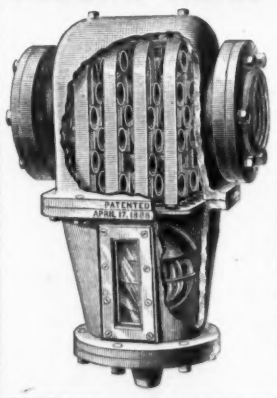
For Blacksmiths, etc. Slow Speed, Positive Blast. Is Durable, Compact and Cheap; also Portable Forges, Tuyere Irons and Foundry Blowers.



P. H. & F. M. ROOTS, Mfrs.
CONNERSVILLE, IND.
S. S. TOWNSEND, Gen. Agt., } 23 CORTLANDT ST., NEW YORK.
COOKE & CO., Selling Agts., }

Please Mention This Paper.

AUTOMATIC GREASE EXTRACTOR.

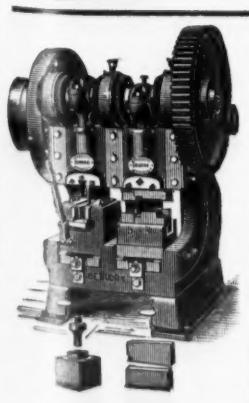


For removing Grease from the exhaust of **Steam Engines.** Causes no back pressure, yet **effectually separates entrained oil & grease,** and automatically delivers it to a suitable receptacle.

EFFECTS A SAVING IN FUEL, OIL, BOILER CLEANING AND REPAIRS.

UNION STONE COMPANY,

38 & 40 HAWLEY ST., BOSTON, MASS.
36 JOHN ST., NEW YORK.



BEAUDRY'S DUPLEX Power Press

COMBINING PRESS, SHEARS AND PUNCH.

BEAUDRY & CO.

(Formerly of Beaudry's Upright Power Hammer.)

Sole Manufacturers.

Also manufacturers of HARD COAL HEATING FORGES.

ROOM 4, MASON B'DG, 70 KILBY ST., Boston, Mass.

BEVEL GEARS,

Cut Theoretically Correct.

For particulars and estimates apply to

HUGO BILGRAM,
Machinist,
Successor to
BREHMER BROS.
440 S. 12th St., Philadelphia, Pa.

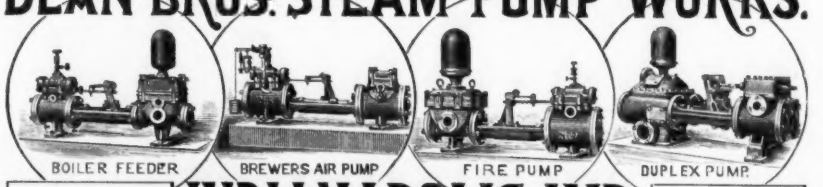
REDUCED PRICES OF LeCOUNT'S STRAIGHT TAIL DOG.

To be driven from a Stud in the Face Plate.

No.	INCH.	PRICE.	No.	INCH.	PRICE
1	¾	$0.60	10	2¼	$1.35
2	⅞	.70	11	2½	1 45
3	1	.70	12	3	1.60
4	1⅛	.80	13	3½	1.80
5	1¼	.80	14	4	2.10
6	1⅜	.95	15	4½	2.75
7	1½	.95	16	5	3.25
8	1¾	1.10	17	5½	4.00
9	2	1 20	18	6	5 00
1 Set to 2 in.		7.80	Full Set		31.10

C. W. LeCOUNT, South Norwalk. Conn.

DEAN BROS.' STEAM PUMP WORKS.



PUMPING MACHINERY FOR ALL PURPOSES.

INDIANAPOLIS, IND.

SEND FOR CATALOGUE AND PRICES.

HALL DUPLEX STEAM PUMPS.

Send for New Catalogue.

Boiler and Pump Combined.

HALL STEAM PUMP CO.,
91 Liberty St., New York.

Fire Pump.

THE VOLKER & FELTHOUSEN M'F'G. CO.

MANUFACTURERS OF
BUFFALO DUPLEX STEAM PUMPS.
HURCH BROS' ALL PACKING STEAM PUMP
BUFFALO, N.Y.

For Sale at Factory Prices by

A. Aller, New York; Walworth Construction and Supply Co., Boston; Henry I. Snell, Philadelphia; Thos. J. Bell & Co., Cincinnati; Shaw, Kendall & Co., Toledo; The George Worthington Co., Cleveland; Goulds & Austin, Chicago; Kennedy & Pierce Machinery Co., Denver, Col.; Sheriff & Ashworth, Pittsburgh, Pa.; Jos. Baur, Manistee, Mich.; Jas. Jenks, Detroit, Wickes Bros., East Saginaw; Adolph Leitelt, Grand Rapids; E. F. Osborne & Co., St. Paul, Minn.; Rundle, Spence & Co., Milwaukee; Joshua Hendy Machine Works, San Francisco, Flynn & Emrich, Baltimore; Forbes, Liddell & Co., Montgomery, Ala.; Bailey & Lebby, Charleston, S.C.; Pond Engineering Co., St. Louis and Kansas City; O. B. Goodwin, Norfolk, Va.; Columbus Supply Co., Columbus, O.; C. S. Leeds & Co., Minneapolis; H. D. Coleman, New Orleans.

WHY THIS IS PUT HERE!

For the reason that if you are interested in raising water or other liquids by steam power, we wish to call your attention to the

NEW PULSOMETER,

THE CHEAPEST AND BEST STEAM PUMP IN THE MARKET. PRICES LOWER THAN ANY OTHER.

More Efficient, Simple, Durable, and more Economical, both as to running expenses and repairs, than any other Steam Pump.

Call or write for our new 96 page Illustrated Descriptive Book containing Full Particulars, Reduced Net Prices, and hundreds of A-1 Testimonials. Mailed Free.

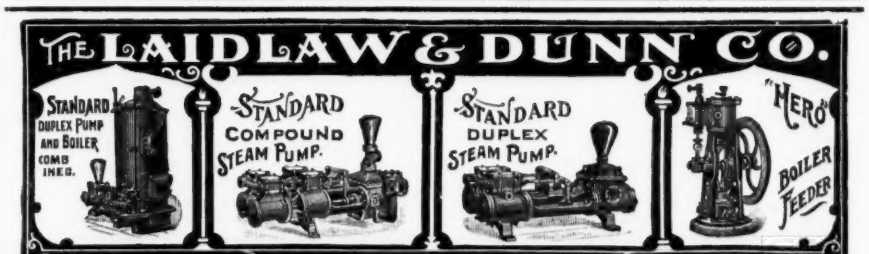
PULSOMETER STEAM PUMP CO., 120 LIBERTY ST., N. Y.

GUILD & GARRISON,

Kent Ave. and South 10th St., Brooklyn, N. Y.

Builders of Steam Pumps, Vacuum Pumps, Vacuum Apparatus, Filter-press Pumps, Air Compressors, Condensers for Pans, Engines, Steam Pumps, Etc.

THE LAIDLAW & DUNN CO.



PUMPS OF EVERY DESCRIPTION. CINCINNATI, O. SEND FOR CIRCULAR.

TO

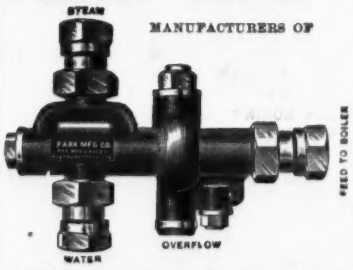
CIVIL, MECHANICAL & MINING ENGINEERS,

ARCHITECTS, BUILDERS, MANUFACTURERS, &c., &c.

Our COMPLETE CATALOGUE of SCIENTIFIC and INDUSTRIAL WORKS will be sent FREE by Mail on application.

JOHN WILEY & SONS, Astor Place, NEW YORK.

PARK MFG. CO.



MANUFACTURERS OF

34 Beach Street, Boston, Mass.

The Park Injector,

EJECTORS AND JET APPARATUS.

BEST PLANE IN THE WORLD.

The Gage Tool Co.'s Self-Setting Plane.

NEW YORK TRADE SCHOOLS,
68TH STREET AND 1ST AVE.

To GAGE TOOL CO., Vineland, N. J.

DEAR SIRS:—I have used the Planes made by your Company, and like them better than any Plane I have ever used.

Yours Resp'y, JAMES DEKAY,
Manager N. Y. T. Schools.

PHILA., PA. April 5th, '88.

GAGE TOOL CO., Vineland, N. J.

Your Plane is the most perfect Plane I ever used. I have been in the business for 40 years and have never found its equal. I could have sold it for double what I paid for it.

C. R. PALMER, 715 N. Broad St.

ASK DEALERS FOR THEM.

Iron Foundry of T. Shriver & Co.,

333 E. 56th St., N. Y. City.

Nice Castings, Smooth and True to Patterns, of very best brands of Pig Iron.

CASTINGS IN QUANTITY AT FAVORABLE PRICES.

WORTHINGTON Independent Condenser

ONLY APPARATUS that can MAINTAIN a VACUUM on ENGINES and ELEVATE the discharge WATER to TANK at any height

This feature is appreciated by PAPER MILLS SUGAR REFINERIES COTTON and WOOLEN MILLS

HENRY R WORTHINGTON
NEW YORK
BOSTON PHILADELPHIA
CHICAGO ST LOUIS SAN FRANCISCO

A PROFITABLE BUSINESS INVESTMENT for the New Year would be to put in the **safest, most economical,** and **best** steam generating plant obtainable.

When preparing to do this, it will pay you to correspond with

HARRISON SAFETY BOILER WORKS,
Germantown Junction, Philadelphia, Pa.

"STEAM"

A VALUABLE BOOK FOR EVERY STEAM USER AND ENGINEER.

PUBLISHED FOR FREE DISTRIBUTION, BY

THE BABCOCK & WILCOX COMPANY,

MANUFACTURERS OF

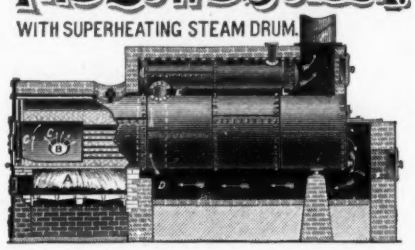
WATER-TUBE BOILERS,

107 Hope St., Glasgow. 30 Cortlandt St., N. Y.

THOS. H. DALLETT & CO.
1305 Buttonwood Street,
PHILADELPHIA, PA.
Portable Drills,
Hand Drills,
Boiler Shell Drills
Light Drill Presses,
Special Machinery.
SEND FOR CATALOGUE.

THE LOWE BOILER

WITH SUPERHEATING STEAM DRUM.



Over fifty years' competition has proven this system of boiler to be the best in every respect. The **LOWE BOILER,** with all improvements, is the simplest, best wearing and most economical of any kind of fuel.

Send for description and histories of Steam Boilers and Feed Water Heaters (free) to

BRIDGEPORT BOILER WORKS,
BRIDGEPORT, CONN.

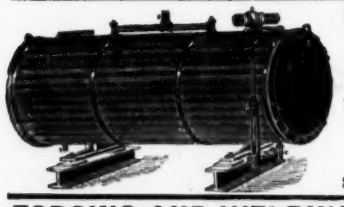
Steam Boilers

FOR ALL PURPOSES,

POND ENGINEERING CO.

St. Louis, Mo.

SEND FOR CIRCULAR.



The HOPPES Live-Steam Feed-Water Purifier,

Guaranteed to Prevent Scale in Boilers,
Using any kind of water. Hard Sheet Steel Troughs, *Easily Cleaned.*

HOPPES MANUFACTURING CO.,
Send for Catalogue D. SPRINGFIELD, OHIO.

FORGING AND WELDING BY PETROLEUM AIR BLAST FIRES.

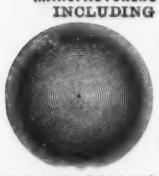
GREAT ECONOMY OVER COAL. SCALING AVOIDED.

Wear of DIES lessened, and better work produced. Insurance not increased. No ASHES or CLINKERS. Continuous fire the whole day. Correspondence solicited.

AERATED FUEL CO., - Springfield, Mass
J. H. BULLARD, Gen'l Manager.
ALDEN SPEARE'S SONS & CO., Boston, Mass., Agents for Eastern part of New England
HARRIS & COWDERY, Ashtabula, Ohio, Agents for O[illegible]

SIMONDS ROLLING MACHINE CO.,
MANUFACTURERS OF ROLLED FORGED SPECIALTIES, INCLUDING

STEEL BALLS



For Anti-Friction Bearings, of Best Cast Steel, Hardened, Ground and Burnished, from 3-16 in. to 2 in. diameter.

In quality and density of metal, in uniformity of temper, and in accuracy and nicety of finish warranted unequaled.

SAMPLES AND PRICES ON APPLICATION.

SIMONDS ROLLING MACHINE CO., Fitchburg, Mass.

VOLNEY W. MASON & CO.,
Friction Pulleys, Clutches and Elevators,
PROVIDENCE, R. I.

Patent CALCULATOR, For Engineers.

Mechanical. Marine. Electrical. Mining. Hydraulic. Heating. Sanitary. Military.

Naval Constructors Architects. Builders. Mechanics. Assayers. Chemists. Scientists. Students.

Size 10x3¼x1½ in. Complete pocket book. All practical problems solved at sight. Mailed on receipt of 75 cents.

R. C. SMITH, No. 1 Broadway, N. Y.

PROVIDENCE, R. I. — I. P. RICHARDS — No 2 1/16 — NEW STANDARD PUNCHES.

Best System on Earth FOR PUNCHING IRON & STEEL

IF YOU ARE INTERESTED IN

INVENTIONS

And Care for Facts About

PATENTS,

Send for PAMPHLET No. 2, for MECHANICS AND INVENTORS.

J. B. CHAMBERLAIN, 500 Fifth St., Washington D. C.

MACHINE TOOLS.

Special or General, any size, for the manufacture of Ordnance, Locomotive, Marine and Stationary Engines, Ships' Boilers, &c., supplied to many leading Firms in the United States of America.

Asquith's Patent Radial Drills

Unequaled by any in the World. Send specification of requirements. Large Stock of Tools ready for delivery.

W. ASQUITH, HALIFAX, England

SEND FOR CATALOGUE.

WORCESTER MACHINE SCREW CO.

Manufacturers of Set, Cap and Machine Screws, Studs, etc.

BAILEY'S PATENT COPPER CAP FUSIBLE PLUG.

A Cheap Means for Preventing Accidents to Steam Boilers through Low Water.

The **fusible metal is kept from contact with the water,** avoiding the chemical and mechanical action, which would otherwise prevent it from melting. Cap is readily removable, permitting free inspection. Highly recommended by the chief Boiler Insurance Companies of Great Britain, over 150,000 being sold in Europe since first introduced, with increasing sales. Also by the U. S. Board of Supervising Inspectors of Vessels at Washington; by Prof. R. H. Thurston, and many other eminent expert engineers, also railway master mechanics, as superior to any now in use, and filling all requirements.

GEO. VAN WAGENEN, Sole American Licensee and Manufacturer.

Illustrated Pamphlets on Application. 233 West Street, New York City.

WESTCOTT CHUCK CO., ONEIDA, N. Y.

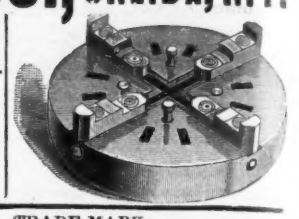
MANUFACTURERS OF

LATHE and DRILL CHUCKS.

SEND FOR CATALOGUE.

GEARED CHUCKS.
Jaws Reversible.

Diameter.	Capacity.
5 inch.	5 inch.
7⅛ "	7¼ "
10⅛ "	10⅛ "
13 "	13⅛ "
15¼ "	17 "
18 "	19¾ "
21 "	25½ "
24 "	28 "



Hydrostatic Machinery
PRESSES,
PUMPS,
PUNCHES,
Accumulators,
JACKS,
VALVES,
FITTINGS,
Vault Elevators, &c. &c.

WATSON & STILLMAN, 204-210 East 43d St., N. Y.

CHUCKS

WRITE US FOR PRICES.

THE HOGGSON & PETTIS MFG. CO.
Est. 1849. NEW HAVEN, CONN.

INDEPENDENT CHUCKS

(See AM. MACHINIST, Nov. 5, 1887.)

Before buying Chucks of this class, write us for particulars of our latest improvements. Different from other makes, and we claim several points of superiority which we submit to the judgment of mechanics.

THE D. E. WHITON MACHINE CO.,
NEW LONDON, CONN.

DIXON'S

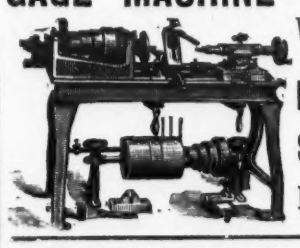
TRACTION
BELT GREASE
—AND—
LEATHER PRESERVATIVE.

Joseph Dixon Crucible Co.,
Manufacturers Pencils and Graphite Specialties,
JERSEY CITY, N. J.

L. S. STARRETT,
Manufacturer of
FINE TOOLS,
ATHOL, MASS.
SEND FOR FULL LIST.

GAGE MACHINE WORKS,

Waterford, N. Y.



Manuf'r's of
FOX, TURRET AND SpeedLathes AND Brass Finishers' TOOLS.

MACHINIST'S SCALES,
PATENT END GRADUATION.
We Invite Comparison for Accuracy with all others.
EVERY SCALE GUARANTEED. SEND FOR LIST.
COFFIN & LEIGHTON, SYRACUSE, N. Y.

TRADE MARK.

HORTON LATHE CHUCK!

Manufactured by

THE E. HORTON & SON CO.,
Windsor Locks, Conn., U. S. A.
Send for Illustrated Catalogue.

A NEW CATALOGUE OF

CUSHMAN CHUCKS

JUST ISSUED.

Containing new designs. Sizes and prices sent free on application to the

CUSHMAN CHUCK CO.,
HARTFORD, CONN.

Emery Wheel 55 Styles & Sizes. **Tool Grinder.**

Guaranteed Satisfactory.

WRITE FOR Ill'd Circular. No. D. Patented Sept. 25, 1883.

SPRINGFIELD Glue & Emery Wheel Co. Springfield, Mass.

Water Prevents HEATING THE WORK.

SHAPING MACHINES

FOR HAND AND POWER.
6", 8" and 10" Stroke.
Adapted to All Classes of Work to their Capacity.
Circulars Furnished.

BOYNTON & PLUMMER,
WORCESTER, MASS.

UNIVERSAL RADIAL and RADIAL DRILLING MACHINES

THREE DESIGNS, SIX SIZES.
EMBODY ALL DESIRABLE FEATURES
PRICES $450.00 & UPWARD
ADDRESS UNIVERSAL RADIAL DRILL CO
CINCINNATI, O. U.S.A.

LATHE Center Grinder

For truing **hardened** centers **in place.**

A cheap and effective tool, needed in every well-regulated machine shop.

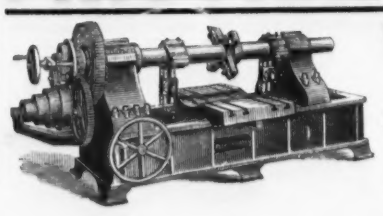
Write for prices to

TRUMP BROS. MACH. CO.
WILMINGTON, DEL.

FRICTION

CLUTCH PULLEYS AND CUT-OFF COUPLINGS

JAS. HUNTER & SON,
North Adams, Mass.



CYLINDER BORING AND FACING MACHINE.

Made any size required. Will bore cylinder and face off the ends at same time. Built strong and powerful; has variable feed that feeds either way.

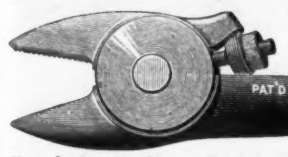
PEDRICK & AYER,
1025 Hamilton St., Philadelphia, Pa.

MORSE TWIST DRILL AND MACHINE COMPANY, New Bedford, Mass.

Manufacturers of **Morse Patent Straight-Lip Increase Twist Drills.**

Solid and Shell Reamers, Beach's Patent Self-Centering Chuck, Bit Stock Drills

DRILL GRINDING MACHINES, MILLING CUTTERS AND SPECIAL TOOLS TO ORDER.

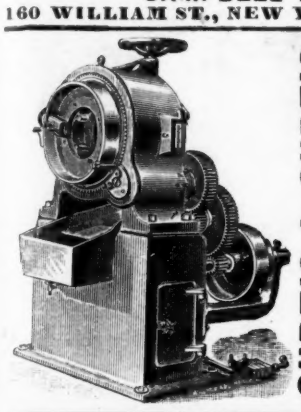


BOYNTON'S ADJUSTABLE ALLIGATOR WRENCH.

Quick and handy in adjustment. Invaluable for work on clipped pipe, in close coils and corners that cannot be reached with other wrenches. Made entirely of drop forged steel. Six sizes. Manufactured by

CAMPBELL PRINTING PRESS AND MFG. CO.

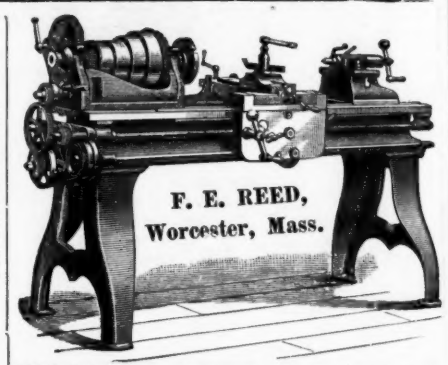
160 WILLIAM ST., NEW YORK. 325 DEARBORN ST., CHICAGO.



CURTIS & CURTIS,

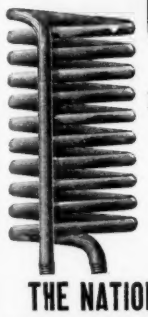
66 GARDEN STREET, BRIDGEPORT, - CONN.

Pipe Cutting and Threading Machinery, FOR HAND OR POWER.



F. E. REED, Worcester, Mass.

ENGINE Lathes, Hand Lathes, Foot Lathes, Upright Drills and Milling Machines. Agents, MANNING, MAXWELL & MOORE, 111 LIBERTY STREET, NEW YORK.



COILS & BENDS

—OF—

IRON, BRASS and COPPER

PIPE.

ALL STYLES.

THE NATIONAL PIPE BENDING CO.,

82 River Street, NEW HAVEN, CONN.

P. BLAISDELL & CO.

Manufacturers of

Machinists' Tools,

WORCESTER, MASS.

SOLDERING Iron and Steel RUST

may be done without causing

by using our **Non-Corrosive** Soldering Fluid.

Sample Bottle, prepaid, for 10 cents

FOR SALE BY ALL DEALERS.

STERLING ELLIOTT, NEWTON, MASS.

BARR PUMPING ENGINE CO

ERECTING PUMPS.

GERMANTOWN JUNCTION.

PHILADELPHIA

DUPLEX PUMPS ALL SIZES. EVERY SERVICE

D. SAUNDERS' SONS

MANUFACTURERS OF THE ORIGINAL

TRADE **I. X. L.** MARK.

PIPE CUTTING & THREADING MACHINE.

BEWARE OF IMITATIONS.

None genuine without our Trade-Mark and Name.

Steam and Gas Fitters' Hand Tools. Pipe Cutting and Threading Machines for Pipe Mill use, a specialty.

Send for Circulars. **YONKERS, N. Y.**

BUFFALO BLOWERS

FOR CUPOLAS, FORGES, FURNACES &C. EXHAUSTERS, STEAM FANS HEATERS & VENTILATING WHEELS.

BUFFALO FORGE CO. BUFFALO, N.Y.

Cincinnati Centennial Exposition.

To the Committee on Rules, Jurors and Awards.

GENTLEMEN:

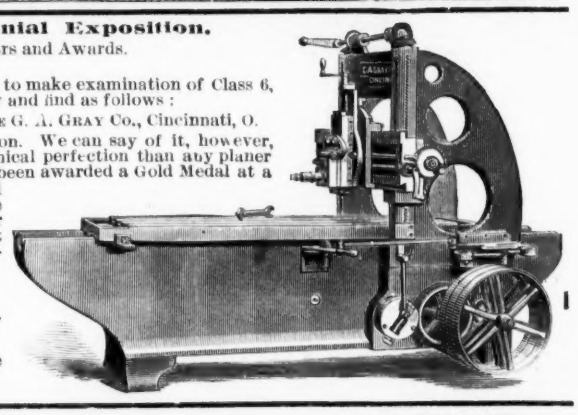
We, your Committee appointed to make examination of Class 6, Group 41, have performed that duty and find as follows:

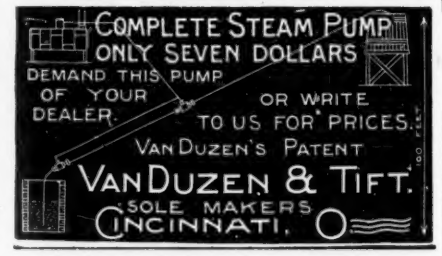
PLANING MACHINE. THE G. A. GRAY CO., Cincinnati, O.

This machine has no competition. We can say of it, however, that it approaches nearer to mechanical perfection than any planer we have ever examined. As it has been awarded a Gold Medal at a former Exposition (Cincinnati,) and as the highest award we could make under the rules would be a Silver Medal, we do not wish to detract from its Golden Record, and therefore make no award.

D. D. MARTIN, WM. CORRY, M. L. ANDREW. } *Jurors.*

The Board of Commissioners have awarded a Silver Medal.





COMPLETE STEAM PUMP ONLY SEVEN DOLLARS

DEMAND THIS PUMP OF YOUR DEALER OR WRITE TO US FOR PRICES.

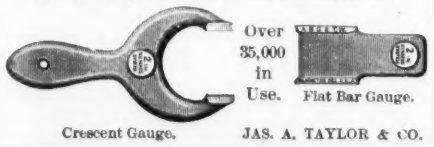
VAN DUZEN'S PATENT

VAN DUZEN & TIFT.

SOLE MAKERS CINCINNATI, O.

American Standard Gauge & Tool Works, Wilmington, Del.

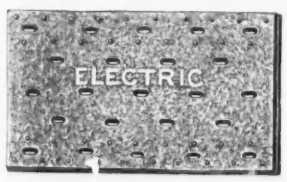
Makers of Implements for Standard Measurements.



Over 35,000 in Use.

Crescent Gauge. Flat Bar Gauge. JAS. A. TAYLOR & CO.

ELECTRIC PERFORATED LEATHER BELTING!!



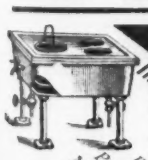
Prevents AIR Cushions. Guaranteed for *DYNAMOS*

Pat. May 24th, 1888.

CHAS. A. SCHIEREN & CO.,

(MANUFACTURERS.)

CHICAGO. PHILA. NEW YORK. BOSTON.



Do You use Glue?

Improved Steam Glue Heaters

without Joints, and therefore free from leakage. Furnished with plain Iron, Enameled Iron or Copper Pots. For Pattern Makers, Cabinet Makers, Joiners, Bookbinders, in fact, all who use Glue. Please mention this paper, and send for Price List to makers. Made in nineteen different styles.

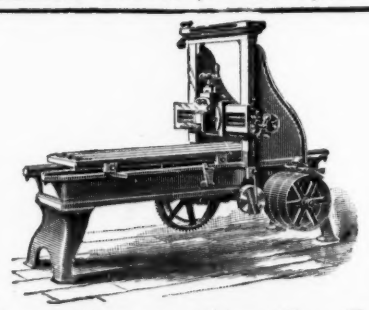
PANCOAST & MAULE,

245 South Third Street, PHILADA. PA.

BUILD THESE

CARY & MOEN CO.

STEEL WIRE OF EVERY DESCRIPTION & STEEL SPRINGS. NEW YORK CITY 22d W. 29. ST.



New Haven Manf'g Co.

NEW HAVEN, CONN.

IRON-WORKING MACHINERY.

McMAHON & COMPANY,

MANUFACTURERS OF

Machinists' Tools,

AND

Patent Friction Pulleys,

Water St., Corner Ledge,

WORCESTER, - - MASS.

Sterling Emery Wheel Co.,

Factory, West Sterling, Mas

Office, 17 Dey Street, New York.

Our Wheels for Machine Shop Work and Tool Grinding Superior to all others.

Send for Catalogue just published.

Chicago Office, 41 South Canal St., Chicago, Ill

W. C. YOUNG & CO., Worcester, Mass

Manufacturers of

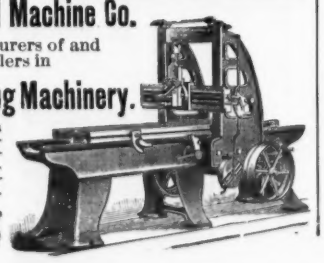
Engine Lathes, Hand Lathes,

FOOT POWER LATHES, SLIDE RESTS, ETC.

L. W. Pond Machine Co.

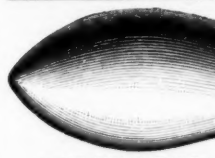
Manufacturers of and Dealers in

Iron Working Machinery.



Improved Iron Planers a specialty. Feed, patented Feb. 9, 1886. Belt Shifter, patented Nov. 2, 1886.

140 Union St., Worcester, Mass.

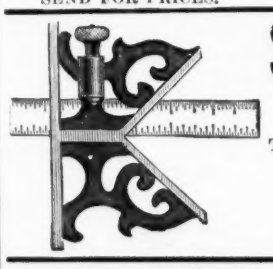


DROP FORGINGS.

WYMAN & GORDON,

Worcester, Mass.

SEND FOR PRICES.



STANDARD TOOL CO.,

ATHOL, MASS.,

MANUFACTURERS OF

The Celebrated Chaplin Try and Center Square, Standard Steel Rules, Steel Caliper Rules, Universal Bevels, Caliper Gauges, Improved Surface Gauges, Bevel Protractors, Depth Gauges, Screw Pitch and Center Gauges, Hardened Steel Squares, Graduated Steel Squares, Spring Calipers, Pliers, Straight Edges, &c., &c.

WRITE FOR ILLUSTRATED CATALOGUE AND PRICE LIST OF FULL LINE.

DRILLING MACHINES.

ALL STYLES WITH

Latest Designs and Improvements. For cuts and prices address,

BICKFORD DRILL CO.,

Front & Pike Sts., Cincinnati, O.

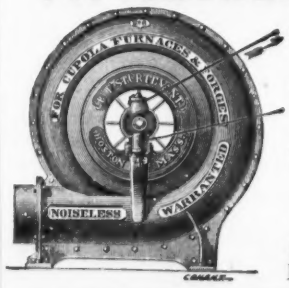
OUR NEW **CATALOGUE OF TOOLS**

And Supplies sent free to any address on receipt of ten Cents in stamps (for postage.)

Chas. A. Strelinger & Co., WOOD AVE., **Detroit, Mich.**

U. BAIRD MACHINERY CO.

PITTSBURGH, PA.



Machinists' TOOLS and SUPPLIES.

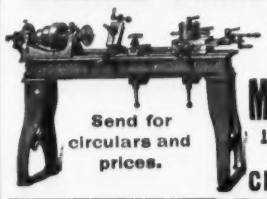
Pattern Makers' TOOLS.

Boiler Makers' TOOLS.

Sturtevant Blowers and Exhaust Fans.

WILLIAM BARKER & CO.,

Manufacturers of



Iron and Brass Working

MACHINERY

Send for circulars and prices.

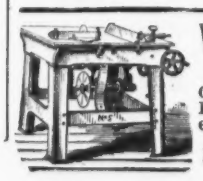
140 & 142 E. Sixth St., Near Culvert,

CINCINNATI, O.

WANTED TOOL AGENTS in Shops South and West of Penna. Send 10c. for Postage on Free Outfit.

C. E. JAMES, 98 Lake St., Chicago.

(Successor to E. H. RANDALL & CO.)



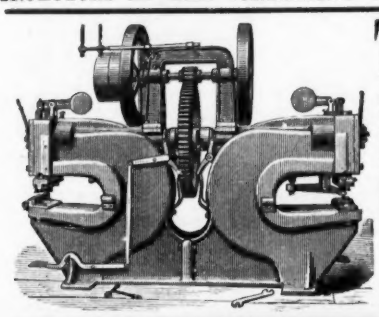
Wood-Working Machinery

For Chair, Furniture and Cabinet Factories, Box Shops, Planing Mills, Pattern Makers' use, etc.

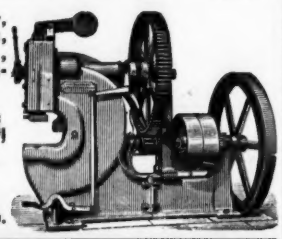
ROLLSTONE MACHINE CO.

45 Water St., Fitchburg, Mass.

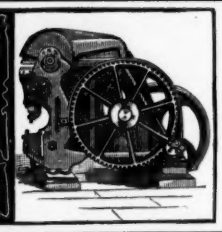
WILLIAM SELLERS & CO., Incorporated.
PHILADELPHIA, PA.
BUILDERS OF
MACHINE TOOLS FOR WORKING IRON AND STEEL,
Improved TURNTABLES for LOCOMOTIVES, CARS and PIVOT BRIDGES.
High Speed Power Traveling Cranes and Hand or Power Swing Cranes, Shafting, Pulleys, Hangers, &c., for transmission of power. Improved Self-Adjusting Injector of 1876. Self-Acting Injector of 1887. Fixed-Nozzle Automatic Injector of 1885.
INJECTORS for ALL CONDITIONS of LOCOMOTIVE and STATIONARY SERVICE.



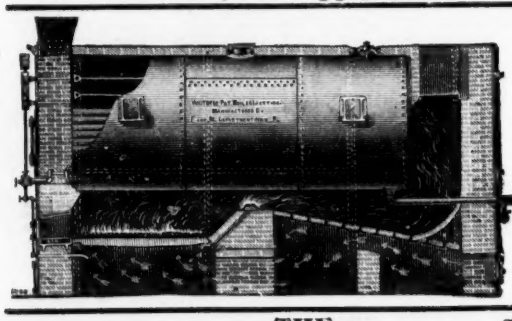
THE LONG & ALLSTATTER CO. Hamilton OHIO.
Double, Single, Angle-Bar, Gang, Horizontal, Twin, Boiler, Spacing, Gate, Multiple, Belt and Steam-Driven
Punches and Shears,
OVER 300 SIZES.
ALSO
Power Cushioned Hammer.
Send for New Catalogue.



PUNCHING AND SHEARING MACHINERY
AND BOILER MAKER'S ROLLS.
NEW DOTY MANUFACTURING CO.
JANESVILLE, WISCONSIN.

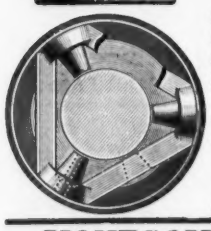


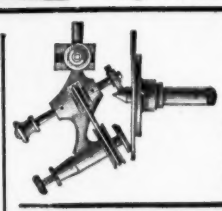
THE BECKETT FOUNDRY & MACHINE CO.
S. A. BECKETT, President. ARLINGTON, N. J. F. A. CHAPMAN, Sec. and Treas.
Successors to THE BECKETT & McDOWELL MFG. CO.
IRON FOUNDERS AND MACHINISTS
MANUFACTURERS OF STEAM ENGINES AND GENERAL MACHINERY. SPECIALTIES: ORE-CRUSHING MACHINERY, STAMP MILLS AND MINING HOISTS.
Having Extensive Foundry Capacity, we are prepared to contract for regular supply of Machinery Castings.



Weitmyer Patent Furnace,
For burning screenings, cheap fuel, etc.
Manufactured and Sold by
FOUNDRY AND MACHINE DEPARTMENT,
HARRISBURG, PA.
Ide Auto. Engines. Portable and Traction Engines. Steam Road Rollers. Boilers of all descriptions.
New York Office, FLEMING & KIMBALL, 17 Dey St.
New England Office, JOHN POST, JR. & CO., 70 Kilby St., Boston.
Baltimore Office, THOMAS K. CAREY & BRO., 35 Light St., Baltimore.

THE BROWNELL ANTI-FRICTION Step or Thrust Bearing
FOR
Lathes, Drills, Worm Shafts of Elevators or Hoists, Jack Screws, Mill Stones, Water Wheel and Propeller Shafts.
Bearings of all sizes made to order, and patent rights for sale by
G. L. BROWNELL,
WORCESTER, MASS.
Correspondence Solicited.





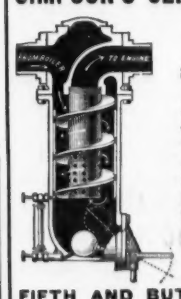
ENERGY MFG. CO.,
1115 South 15th St.,
PHILA., PA.
Sole makers of Rope Hoisting Machines, Drill Guides, etc. Two sizes of Center Grinders, for small and large lathes. Will true up centers quicker than any other device. Send for descriptive circular of specialties.

DELAFIELD'S PAT. SAW CLAMP

With Saw for Cutting Metals. Saves all the broken hack saw blades. In use over two years, in all parts of the country. The new Clamps have the edges beveled that hold the saw. Free by mail for 50 cents. Extra blades, 1-2 in. wide, 7c. each. 70c. per doz; 1 in. wide, Stubs, 35c. each. Free by mail.
NOROTON MFG. WORKS, NOROTON, CONN.

MONTGOMERY & CO.,
105 FULTON ST., NEW YORK
TOOLS, SUPPLIES AND MACHINERY
FOR ALL BRANCHES OF THE MECHANICAL TRADES.
Illustrated Catalogue (300 pages) mailed on receipt of Fourteen Cents.

SIMPSON'S CENTRIFUGAL SEPARATOR AND TRAP.



For supplying Clean and Dry Steam to Engines, Dryers, Etc. Also *Keystone Feed-Water Heaters and Purifiers, Keystone Belt Pumps, Simpson's Centrifugal Exhaust Heads* and other Engineering Specialties. Steam Plants furnished complete and erected. Send for particulars.
KEYSTONE ENGINE AND MACHINE WORKS,
FIFTH AND BUTTONWOOD STS. PHILA.,
Or, ARTHUR APPLETON, Selling Agent, 45 Cortlandt St., N. Y.

WELDLESS STEEL QUICK OPENING GATE VALVE. COLD DRAWN TUBES
SMOOTH INSIDE & OUT. JOHN S. LENG, 4 Fletcher St. N.Y.

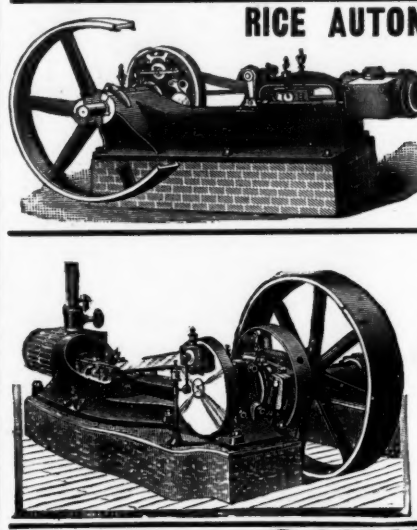
OSGOOD DREDGE CO., Albany, N. Y.
RALPH R. OSGOOD, Pres. JAMES H. BLESSING, Vice-Pres.
JOHN K. HOWE, Secretary and Treasurer.
MANUFACTURERS OF
DREDGES, EXCAVATORS, DITCHING MACHINES, DERRICKS, ETC., ETC.

Combined Steam Excavator and Derrick Car.

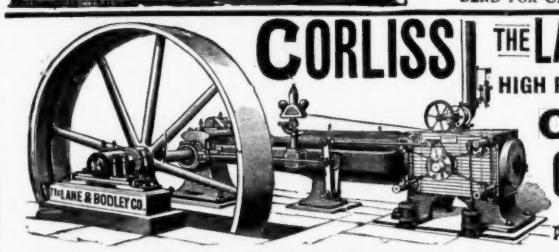
OPEN SIDE IRON PLANERS
FOR QUICK DELIVERY.
1 30"x25"x 6 ft. Size "C."
1 30"x25"x 8 ft. Size "C."
1 30"x25"x10 ft. Size "C."
1 36"x30"x 8 ft. Size "D."
1 36"x30"x10 ft. Size "D."
1 48"x36"x10 ft. Size "E."
1 48"x36"x14 ft. Size "E."
1 48"x48"x12 ft. Size "E. 1."
1 48"x48"x14 ft. Size "E. 1."
WRITE FOR PRICES, PHOTOTYPES, Etc.
Detrick & Harvey,
BALTIMORE, MD.

BEMENT, MILES & CO.,
PHILADELPHIA, PA.
—BUILDERS OF—
METAL-WORKING MACHINE TOOLS
FOR
Railroad Shops, Locomotive and Car Builders, Machine Shops, Rolling Mills, Steam Forges, Ship Yards, Boiler Shops, Bridge Works, Etc., Etc.

RICE AUTOMATIC CUT-OFF ENGINE.
Self-Contained. Sensitive Governor. Balanced Valve. High Speed. Stationary Oilers. Best Economy.
Gold Medal Cincinnati Exposition, 1884.
THE JOHN T. NOYE MFG. CO.,
BUFFALO, N. Y.

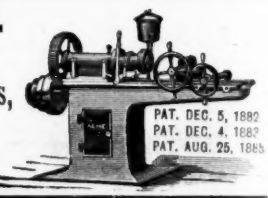


Russell & Co.
MASSILLON, OHIO,
BUILDERS OF
AUTOMATIC ENGINES
BOILERS, ETC.
Complete Power Plants Furnished and Erected.
SEND FOR CATALOGUE.



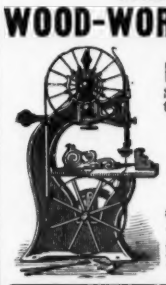
CORLISS | THE LANE & BODLEY CO.
HIGH PRESSURE, CONDENSING and
COMPOUND CORLISS ENGINES AND STEAM OUTFITS
THE LANE & BODLEY CO., EAST SIDE JOHN, Corner WATER ST. CINCINNATI, O.

ACME MACHINERY CO.
CLEVELAND, OHIO.
Manufacturers of "ACME"
Single & Double Automatic Boltcutters,
Cutting from 3-8 in. to 6 in. diameter.
Also SEPARATE HEADS and DIES.
Send for Catalogues and Discounts.
FIRST PREMIUM, CINCINNATI CENTENNIAL.



STEEL CASTINGS
From 1-4 TO 15,000 lbs. WEIGHT.
True to pattern, sound, solid, free from blow-holes and of unequaled strength.
Stronger and more durable than iron forgings in any position or for any service whatever.
40,000 CRANK SHAFTS and 30,000 GEAR WHEELS of this steel now running prove this.
Cross-Heads, Rockers, Piston-Heads, etc., for Locomotives.
STEEL CASTINGS of every description.
Send for Circulars and prices to
CHESTER STEEL CASTINGS CO.,
Works, Chester, Pa. Office 407 Library St., Philadelphia, Pa.

J. A. FAY & CO. CINCINNATI, OHIO, U.S.A.
BUILDERS OF IMPROVED
WOOD-WORKING MACHINERY
Embraces nearly 400 Machines for
PLANING & MATCHING
Surfacing, Moulding, Tenoning, Mortising, Boring, and Shaping, etc.
Variety and Universal
WOOD WORKERS.
Band, Scroll and Circular Saws, Resawing Machines, Spoke and Wheel Machinery, Shafting, Pulleys, etc. All of the highest standard of excellence.
W. H. DOANE, Pres. D. L. LYON, Sec'y.



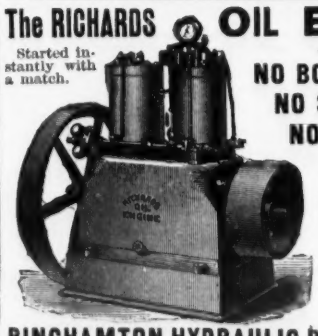
PECK'S PAT. DROP PRESS.
NEW HAVEN
BEECHER & PECK, CONN.
DROP FORGINGS OF IRON OR STEEL
BEECHER & PECK, NEW HAVEN CONN.

"TWENTY YEARS WITH THE INDICATOR."
[PRAY.] Vols. 1 and 2 (one volume.) Seventh thousand. Large 8vo. 285 pp., many illustrations. Price $2.50. JOHN WILEY & SONS, 15 Astor Place, New York.

PATENTS THOMAS P. SIMPSON, Washington, D. C. No atty's fee until Patent obtained. Write for Inventor's Guide.

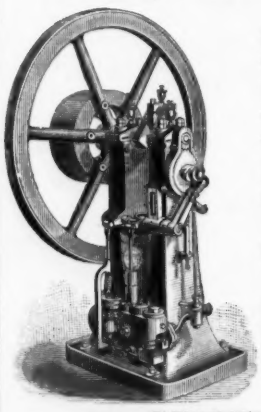
MACHINERY For Reducing and Pointing Wire.
ESPECIALLY ADAPTED TO POINTING WIRE RODS AND WIRE FOR DRAWING.
For Machines or information, address the manufacturer,
S. W. GOODYEAR, Waterbury, Ct.

The RICHARDS OIL ENGINE.
Started instantly with a match.



NO BOILER.
NO STEAM.
NO DANGER.
Fuel, Crude Petroleum or Kerosene.
Cheaper than all others.
BINGHAMTON HYDRAULIC POWER CO.
BINGHAMTON, N. Y., U. S. A.,
SOLE MANUFACTURERS.

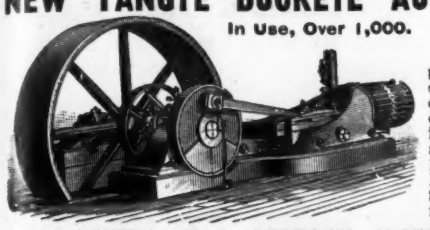
KORTING GAS ENGINE.
1 to 100 Horse Power.



The Korting Gas Engine is placed upon its merits and under full guarantee to every purchaser.
OVER 125 IN USE IN N. Y. CITY.
CATALOGUES on APPLICATION.
KORTING GAS ENGINE CO., LIMITED.
429, 431 & 433 Greenwich Street,
Cor. Laight Street, NEW YORK CITY.

NEW TANGYE BUCKEYE AUTOMATIC CUT-OFF ENGINES.

In Use, Over 1,000. 25 to 1,000 H. P.



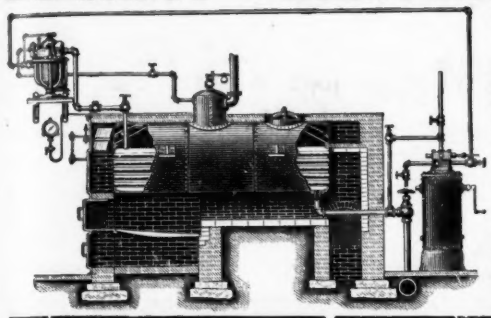
These engines are the combined result of long experience with automatic cut-off regulation, and most careful revision of all details. They are designed and constructed for heavy and continuous duty at medium or high rotative speeds. Highest attainable Economy in Steam Consumption and superior regulation guaranteed. Self-contained Automatic Cut-off Engines 12 to 100 H.P. for driving Dynamo Machines *a specialty*. Illustrated Circulars, with various data as to practical Steam Engine Construction and performance, free by mail. Address, BUCKEYE ENGINE CO., Salem, Ohio.

SALES AGENTS: W. L. SIMPSON, 301 TELEPHONE BUILDING, 18 CORTLANDT STREET, N. Y. / N. W. ROBINSON, 154 Washington St., Chicago, Ill. / ROBINSON & CARY, St. Paul, Minn.

KENSINGTON ENGINE WORKS, LIMITED, PHILADELPHIA.

Sole Licensees and Manufacturers for New Jersey (South of Trenton), Eastern Pennsylvania, Delaware, Maryland and Virginia.

BLESSING'S WATER CIRCULATOR AND PURIFIER.



Guaranteed to Absolutely Prevent Formation of Scale in Steam Boilers.

Automatically takes water from the boiler, filters, it and returns it in pure condition, thus removing scale-making impurities from the water, and maintaining a free and steady circulation. Combines the well-known Albany Steam Trap with a Filter of novel construction, which has no rival in point of simplicity, facility for cleaning, and assurance against clogging of sand valve.

Send also for Circulars of Albany Steam Traps, Blessing's Renewable-Seat Stop and Check Valves, Pump Governors, Water Circulators and Purifiers, etc.

Albany Steam Trap Co., ALBANY, N.Y.

"OTTO" GAS ENGINE WORKS.

SCHLEICHER, SCHUMM & CO.,

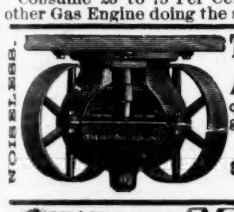
33d & Walnut Streets, Philadelphia. 130 Washington Street, Chicago.

New York Agency, 18 Vesey St.

OVER 25,000 ENGINES SOLD.

HORIZONTAL "Otto" Gas Engines.
VERTICAL "Otto" Gas Engines.
TWIN CYLINDER "Otto" Gas Engines.
COMBINED "OTTO" GAS ENGINES AND PUMPS.
COMBINED "OTTO" GAS ENGINES AND DYNAMOS.

Consume 25 to 75 Per Cent. Less Gas than ANY other Gas Engine doing the same work.



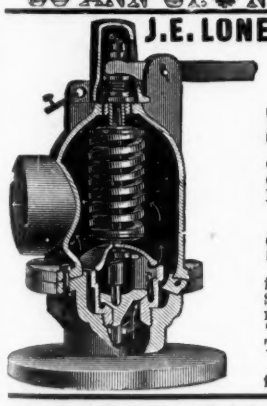
The Almond Coupling

A NEW quarter turn motion to replace quarter turn belts and bevel gears.

T. R. ALMOND, MFR., 33 and 35 Washington Street, BROOKLYN, N. Y.

NOISELESS.

CHARLES MURRAY
ENGRAVER ON WOOD
58 ANN ST. NEW YORK.



J. E. LONERGAN & CO.

211 Race St., Phila.

Manufacturers of

PATENT OILERS,

Cylinder Sight Feed Cups. Government Regulation

POP SAFETY VALVES

for Locomotive Stationary and Marine Boilers. also the "Reliable" Steam Trap.

1888 Catalogue free on application.

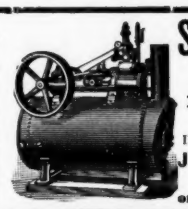
MACHINERY ON HAND.

16 in. x 42 in.	Planer.	Bridgeport,	new.
22 in. x 4-5 and 6 ft.	"	Powell,	"
24 in. x 6 ft.	"	Powell,	"
30 in. x 8 ft.	"	each Atherton, Powell & H. & P.	new.
12 in. x 5 1-2 ft.	Engine Lathe,	S. M. & Co.	new.
12 in. x 6 ft.	"	Young,	"
13 in. x 6 ft.	"	Ames,	"
14 in. x 6 ft.	"	Blaisdell,	"
14 in. x 7 ft.	"	Bogart,	"
14 in. x 6 ft	"	Gap Bed, S. M. & Co,	"
15 in. x 6 and 8 ft.	"	Porter,	"
16 in. x 6 and 8 ft.	"	Blaisdell,	"
16-20 in. x 6-8-10 & 12 ft.	"	Bridgeport,	"
18 in. x 8-10-12 ft.	"	Different Makes,	"
20 in. x 8-10-14 ft.	"	Different Makes,	"
20 in. any length Bed	"	Bridgeport,	"
22 in. x 12 ft.	"	Niles,	heavy, good.
25 in. x 8-10-12 & 14 1 2	"	Br dgeport,	new.
26 in. x 14 ft.	"	Wright,	"
28 in. x 14-16 & 18 ft.	Engine Lathes,	T. & S.	"
20 in.	Drill	Davis,	"
20-23-25-28 inch	Drills	Blaisdell,	"
20-25-28-32 inch	"	C. & S.	"
5 ft.	Arm Universal Radial Drill,		"
Cabinet Turret Lathe,	Lodge, Davis & Co.		"
No. 5 Screw Machine,	Jones, Lamson & Co.		"
No. 2-4 "	" Brown & Sharpe.		"
No. 2 Garvin Hand Miller,			A 1.
No. 5 Brainard	"		A 1.
Lincoln Pattern,	"		good order.
No. 1 and 3 Universal Miller,	Brown & Sharpe,		new.
No. 1-2 and 5 Plain "	"	"	"
No. 1 Universal Grinder,	"	"	"
No. 3 Surface Grinder,	"	"	A 1.

Cold Rolled Shafting in Stock. Send for list. Write for what is wanted.

E. P. BULLARD,

62 COLLEGE PLACE & 72 WARREN ST., NEW YORK.



STEAM ENGINES

Upright and Horizontal, Stationary, Portable and Semi-Portable.

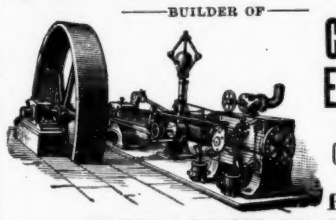
8 to 16 Horse Power.

Illustrated Pamphlet Free. Address

JAMES LEFFEL & CO SPRINGFIELD, OHIO, or 110 Liberty St., New York.

JOHN McLAREN.

BUILDER OF

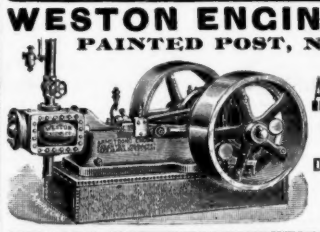


CORLISS Engines, AIR Compressors and BOILERS.

HOBOKEN, N. J.

WESTON ENGINE CO.

PAINTED POST, N. Y.

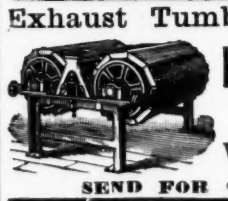


THE ARMSTRONG ENGINE.

CORRECT IN Design, Workmanship and Price.

5 to 75 H. P.

Exhaust Tumbling Barrels.



Henderson Bros.

MANUFACTURERS,

WATERBURY, CT.

SEND FOR CIRCULAR.

ATTENTION NEW ENGLAND BUYERS.

We have opened at 23 and 25 Purchase St., Boston, a depot for the exhibition and sale of our Improved Engine Lathes, Shapers, Drill Presses and Brass Working Machine Tools, &c. We make a feature of Complete Engine Lathes, without charge for extra attachments.

Call and examine them. Cuts, with full descriptions, free.

LODGE, DAVIS & CO.

23 & 25 Purchase St.,

BOSTON.

WORKS, Cincinnati, Ohio.

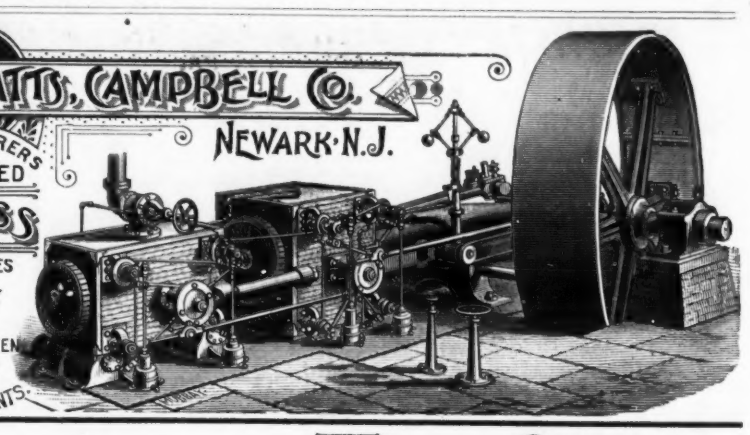
See Advertisement, Page 16.

THE WATTS, CAMPBELL CO.

NEWARK, N.J.

MANUFACTURERS OF IMPROVED CORLISS STEAM ENGINES IN FULL VARIETY.

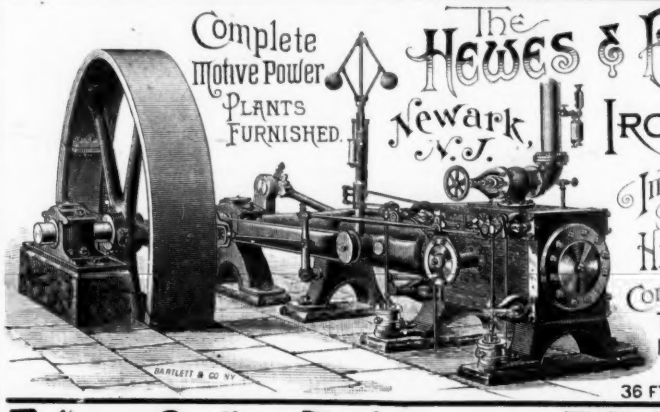
CONTRACTS TAKEN FOR COMPLETE POWER PLANTS.



The Hewes & Phillips Iron Works

Newark, N.J.

Complete Motive Power Plants Furnished.



Improved CORLISS ENGINES. High Pressure. Condensing and Compound

TUBULAR BOILERS.

HEAVY FLY WHEELS A SPECIALTY.

IN SIZES UP TO 36 FT. DIA. BY 10 FT. FACE.

Eclipse Corliss Engine.

FRICK COMPANY, Builders, WAYNESBORO, PA.

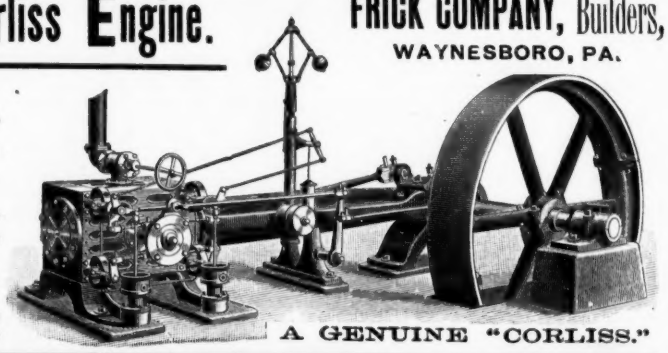
NON-CONDENSING, CONDENSING COMPOUND.

40 TO 1,000 H.P.

Send for Circulars.

E. P. HAMPSON & CO., 36 CORTLANDT ST., NEW YORK, Sole Eastern Agents.

JOHN J. METZGER, 69 S. Clinton St., Chicago, WESTERN AGENT.

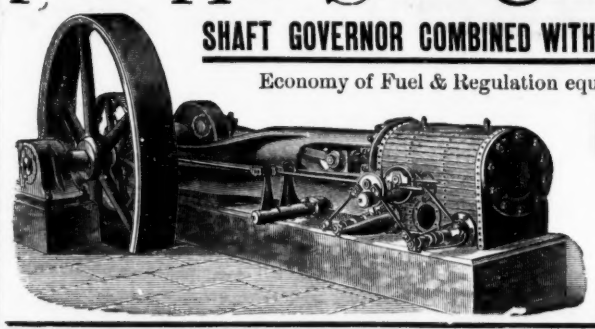


A GENUINE "CORLISS."

PAYNE HIGH SPEED CORLISS ENGINE.

SHAFT GOVERNOR COMBINED WITH CORLISS WRIST-PLATE.

Economy of Fuel & Regulation equal to anything in use.



B. W. PAYNE & SONS

ELMIRA, N. Y.

45 Dey St., New York.

Hill, Clarke & Co., Boston, Mass.

10 S. Canal St., Chicago, Ill.

BALL AUTOMATIC CUT-OFF ENGINES,

ERIE, PA.

The characteristics of these Engines are Beauty of Design, Superior Finish, Limited Feet in Space required, Economy of Fuel, Perfection of Regulation.

CHARLES R. VINCENT & CO.,

NEW YORK SELLING OFFICE, 15 CORTLANDT STREET.

STEARNS M'F'G CO.

ERIE, PA.

ENGINES from 15 to 400 Horse Power

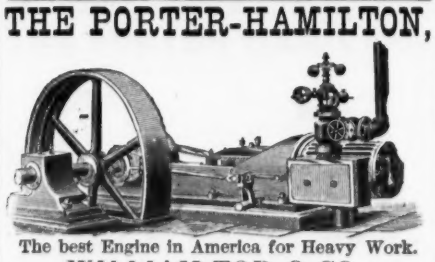
Boilers of Steel and Iron supplied to the trade or the user. Send for Catalogue.

SAW MILLS and GENERAL MACHINERY

NEW YORK STORE, 46 Cortlandt St.

BORING AND TURNING MILLS. LATHES PLANERS DRILL PRESSES F. P. MICHEL ROCHESTER N.Y.

THE PORTER-HAMILTON,



The best Engine in America for Heavy Work.

WILLIAM TOD & CO., Youngstown, Ohio.

HILL, CLARKE & CO.

List of Second-Hand

MACHINERY.

15"x 6' Engine Lathe,	Lathe & Morse.
16"x 6' Engine Lathe,	Powell.
16"x 6' Engine Lathe,	Blaisdell.
16"x 6' Engine Lathe Taper,	Reed.
18"x 6' Engine Lathe,	Blaisdell.
20"x 8' Engine Lathe,	Powell.
21"x10' Engine Lathe,	Lathe & Morse, (new).
27"x16' Engine Lathe,	Lathe & Morse, (new).
37"x14' Engine Lathe,	Gleason, (new).
Cabinet Turret Lathe,	Lodge, Davis & Co. (new).
16'x16"x 3' Planer,	Lathe & Morse.
22"x22"x 5' Planer,	Hendey.
26"x26"x 6' Planer,	Hendey.
30'x30"x 8' Planer,	Bement.
36'x36"x10' Planer,	Whitcomb, (new).
15" Stroke Shaper,	Hendey.
Crank Planer,	Lathe & Morse.
20" Upright Drill,	Prentice.
22" Upright Drill,	Reed.
28" Upright Drill,	Bickford.

Above 2d-hand tools are in first-class condition. Write for prices and descriptions.

156 OLIVER STREET,

BOSTON, MASS.

THE UNIVERSAL GRINDING MACHINE,

Made by BROWN & SHARPE MFG. CO., Providence, R. I., U. S. A.

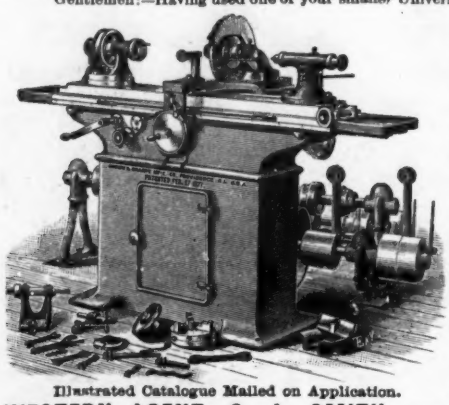
TESTIMONIALS.

Wm. B. Bement & Son, Mfrs. of Machine Tools, Steam Hammers, etc.,
Callowhill and 21st Sts., Philadelphia, Feb. 13, 1885.

Brown & Sharpe Mfg. Co., Providence, R. I.

Gentlemen:—Having used one of your smaller Universal Grinding Machines for four years, and another of the larger size for nearly two years, it gives us pleasure to say that they produce economically and well all the kinds of work for which they are intended, and we could not dispense with them. Yours truly,

Wm. B. Bement & Son.



Wm. Sellers & Co., Philadelphia, Feb. 7, 1885.

Brown & Sharpe Mfg. Co., Providence, R. I.

Gentlemen:—In reply to your inquiry of the 6th inst., we have to say that we have been using your "Universal Grinding Machine" almost constantly since June, 1880, with very satisfactory results. We hope to add more to our plant as business increases. Yours truly,

Wm. Sellers & Co.

Pratt & Whitney Co., Mfrs. of Machinists' Tools, Hartford, Conn., Feb. 7, 1885.

Brown & Sharpe Mfg. Co.

Gentlemen:—We have had in use since Aug. 1882, one of your Universal Grinding Machines, and since then have bought two more. We find them indispensable in our shop. It has become with us pretty well understood, that there is no way to make a good journal bearing and other cylindrical surfaces, except by grinding. Such a machine must be perfect in its construction to answer the purpose. We find that these machines respond to all the requirements. Very truly yours, The Pratt & Whitney Co.,

F. A. Pratt, Pres't.

We have just published a Treatise on the Construction and Use of Universal Grinding Machines, fully illustrated. Sent by mail on receipt of P.O. money order for $1.33.

Illustrated Catalogue Mailed on Application.

WESTERN AGENT, S. A. SMITH, 23 South Canal Street, Chicago, Ill.

THE PRATT & WHITNEY COMPANY,

Hartford, Conn.

MANUFACTURE

PLANERS

To plane 16 in. x 16 in. x 3 ft., to 60 in. x 60 in. x 20 ft., with quick return motion.

PILLAR ✣ SHAPERS

With 6 in. x 10 in. stroke.

SHAPING MACHINES

With 12 in. and 14 in. stroke, all feeds automatic.

PRICE LIST

—AND—

Discount Sheet

SENT UPON APPLICATION.

WESTERN BRANCH:
100 West Washington St., Chicago, Ills.

THE BILLINGS & SPENCER COMPANY,

HARTFORD, CONN.,

MANUFACTURERS OF

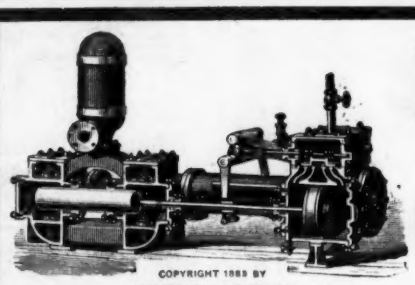
Billings' Improved Combination Pliers,

Drop Forged from Tool Steel.

DROP FORGINGS In Copper, Iron or Steel, for Electric Motors and Generators, Guns, Pistols, Sewing Machines,

MACHINISTS' TOOLS AND Machinery Generally.

Send for Illustrated Catalogue.



Duplex Steam Pumps

AND

Water Works Machinery.

COPYRIGHT 1888 BY THE GORDON & MAXWELL CO.

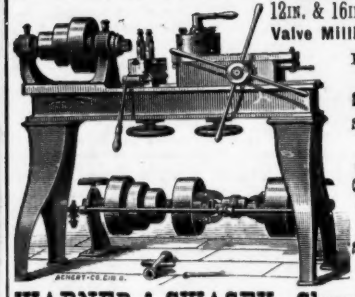
THE GORDON STEAM PUMP CO.

HAMILTON, OHIO.

BRANCH HOUSES:

NEW YORK, 96 Liberty Street.
PHILADELPHIA, 705 Arch Street.
CHICAGO, 96 Lake Street.

BRASS WORKING MACHINERY.



12IN. & 16IN. MONITORS.
Valve Milling Mach's
Double Key Lathes,
SpeedLathes,
Slide Rests,
Revolving Chucks for Globe Valves
Two-Jawed Chucks,
Small Tools and Fixtures.

WARNER & SWASEY, Cleveland, O.

REMOVAL.

THE POND MACHINE TOOL COMPANY,

Formerly of Worcester, Mass.

The new shops of this company are located at Plainfield, N. J., forty minutes' ride from New York city on the line of the Central Railroad of N. J., and consist of the following:

A machine shop 500′ long by 100′ wide; a foundry 250′ long by 90′ wide; also commodious buildings for the storage of sand, coal, coke and pig iron; ample and convenient wash rooms for the men; fireproof two story pattern storage; blacksmith shop; engine and boiler houses. These buildings are detached from the machine shop and foundry. There is an elevated railroad for the convenient distribution of raw materials, and a railroad running through the machine shop for shipping. The whole plant is supplied with the incandescent system of electric lighting.

The machine shop and foundry have overhead traveling cranes running through their entire lengths; also light traveling cranes, which serve every tool, and a number of jib cranes in the foundry and scratch rooms. The foundry has capacity for making the heaviest class of castings.

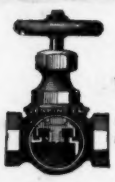
All our tools are expressly designed for the economical manufacture of heavy machinery for railroad and general machine shop equipment, from new patterns of the latest and best designs.

SALESROOM and OFFICE, 111 & 113 Liberty St., N. Y. City.
NEW SHOPS, Plainfield, N. J.

CRANES

THE YALE & TOWNE MFG CO.
STAMFORD CONN
NEW YORK CHICAGO PHILA BOSTON

IMPORTANT TO USERS OF VALVES.



Owing to the popularity the JENKINS BROS. VALVES have attained, the market has been subjected to BASE IMITATIONS.

One important defect in the imitations referred to is *insufficient opening* for inlet *of steam or* Fluid, *thereby checking the flow.* Purchasers of Valves should be careful to know that they are of capacity suited to size of pipe to which the Valves are to be attached. All Valves manufactured by

Jenkins Bros. are Warranted Full Opening.

JENKINS BROS., 71 John St., N. Y. 105 Milk St., Boston. 21 North Fifth St., Phila. 54 Dearborn St., Chicago.

GEO. W. FIFIELD,

MANUFACTURER OF

ENGINE LATHES

FROM 16 to 48 IN. SWING.

Cuts, Photographs and Prices furnished on application.

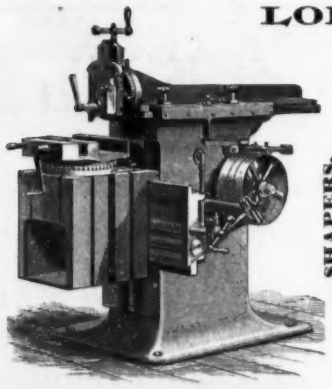
Lowell, Mass., U. S. A.

J. M. ALLEN, PRESIDENT.
W. B. FRANKLIN, VICE-PRESIDENT
J. B. PIERCE, SECRETARY.

SHAPERS, ENGINE LATHES AND DRILLS.

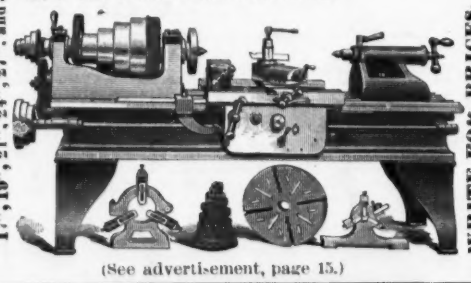
LODGE, DAVIS & CO.,

CINCINNATI, OHIO.



SHAPERS, 8", 10", 15", 20", 26", 32" Stroke.
ENGINE LATHES, 17", 19", 21", 24", 27" and 38".

20 inch Upright Drills. 25 inch Back Geared, and
24 " " " "
28, 32 and 40 inch Power Feed Drills.



WRITE FOR PRICES, IT WILL PAY YOU.

(See advertisement, page 15.)

Gear Wheels and Gear Cutting.—I make g to order, or cut teeth on g blanks sent to me. Of all kinds. Of all sizes to six ft. dm. Small orders or large ones. Fine g or cheap g. Small cast g. Ready made brass g by mail at low prices. Bevel g with perfect planed teeth. Hand Book on g, $1. Facilities complete. Terms reasonable. Send for cat. GEO. B. GRANT, 66 Beverly St., Boston, Mass.

KEY-SEATING MACHINES

AND

20 in. Drills a Specialty.

Our 20 in. Drill is a heavy substantial tool, made for service, has steel shafts and spindle. Gears and racks cut from the solid, and have all modern improvements, are made by special machinery, and sold very low.

Our Key-Seating Machine will save enough in 60 days' use to pay first cost; no shop can afford to do without one. We have now ready for prompt shipment, both Key-Seat Machines and 20in. Drills. Send for Photo. and Catalogue.

W. P. DAVIS, North Bloomfield, N. Y.

PATENT UNIVERSAL SCREW-CUTTING CENTER DEPTH ANGLE AND **J. WYKE & CO., TWIST DRILL GAUGE.**

Fine Machinists' Tools.—E. Boston, Mass—Send for Circular

NEW CATALOGUE

MACHINE TOOLS.

THE G. A. GRAY CO.,

477-481 SYCAMORE ST., CINCINNATI, O.

See advertisement, page 18.

WHAT our customers say about the

Eberhardts Patent Drill Press.

The only one built on **correct principles.**
More **economical** than any we have ever used.
Can do **double** the work. Most convenient.
Best in the market. Much admired.
No trouble or expense for repairs.
Could not ask for anything better.
There may be as good a one made by some one else, but **I have not seen it.**
I feel that **I did wisely** in buying your tool.
We consider it a **model tool** and fills the whole bill.

Below we give the names of a few prominent users of these machines. Their appreciation can be estimated from the number of machines in use.

Missouri Pacific Railway Co., St. Louis, Mo.	3 Machines.
Eames Vacuum Brake Co., Watertown, N. Y.	4 "
Carnegie, Phipps & Co., Pittsburgh, Pa.	2 "
American Brake Co., St. Louis, Mo.	3 "
Worthington Pump Works, Brooklyn, N. Y.	2 "
King Iron Bridge Works, Cleveland, O.	9 "
Filler & Stowell Mfg. Co., Milwaukee, Wis.	2 "
Hutchinson, Hollingsworth & Co., England	3 "
Daft Electric Light Co., Marion, N. J.	2 "
C. H. Hunt & Co., New York City	2 "

Also, Standard Oil Company, Lima, O.
Morgan Engineering Co. Alliance, O.
Grand Trunk Railway of Canada, Montreal, Can.
Brainard Milling Machine Co., Hyde Park, Mass.
Boston Bridge Works, Boston, Mass.

Write to

GOULD & EBERHARDT,

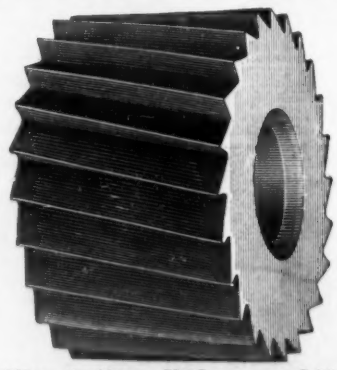
For Catalogue A. NEWARK, N. J.

E. E. CARVIN & CO.

139 & 141 Centre Street, N. Y.,

MANUFACTURERS OF

MACHINISTS' TOOLS



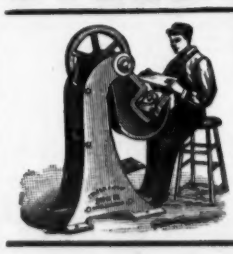
Milling Cutters all Shapes and Sizes.

Straight or Spiral Teeth. Width of face, 1-8 in. to 3 in. Diameter, from 2 1-4 in. to 2 3-4 in.

SEND FOR CATALOGUE.

STEEL CASTINGS.

PRATT & LETCHWORTH,
PROPRIETORS
Buffalo Steel Foundry,
BUFFALO, N. Y.



PUNCHING PRESSES, DIES,

And other Tools for the Manufacture of all kinds of

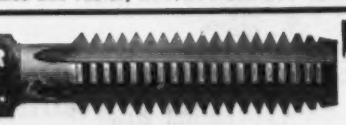
SHEET METAL GOODS, DROP FORGINGS, ETC, DROP HAMMERS.

STILES & PARKER PRESS CO.

MIDDLETOWN, CONN.

Branch Office and Factory 203, 205 and 207 CENTRE STREET, NEW YORK.

J.M. CARPENTER
PAWTUCKET, R.I.



Manufacturer —of— TAPS & DIES